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SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS

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Processing Methods for Use With Two New Black-and-White Reversal Films

By C. E. IVES, J. W. ZUIDEMA, N. A. EXLEY and C. C. WILT

Two new 16mm black-and-white reversal films (Eastman Plus-X Reversal Film, Type 7276; Eastman Tri-X Reversal Film, Type 7278) have been introduced to satisfy the present-day requirements for extended speed range, improved picture quality, and ease of processing in rapidly working baths at normal and elevated temperatures. A study has been made of the reversal process with reference to the needs of these films when handled on various types of continuous and batch equipment of practical interest. Recommendations are made for processing-bath composition and replenishing practice for obtaining highest quality and consistent results.

THE PROCESSING method employed for a substantial proportion of 16mm motion-picture camera films is of the type which produces a positive directly in contrast to the two-step negative-positive method used almost universally for 35mm work. While the history of direct-positive methods goes back as far as Daguerre, the chemical reversal procedure which is now used for the direct production of a positive image was first suggested by C. Russell[1] in 1862. In this process, advantages of simplification in equipment and saving of time and money result from the production of "direct-positive" pictures for projection on the same film that was exposed in the camera. The method consists in developing the silver halide positive image remaining after the initial negative image has first been developed and than dissolved out. In the ordinary process of producing a negative, the positive residual silver halide image would be removed in fixing.

This reversal method was little used for over half a century until its adoption for amateur 16mm motion-picture photography in 1923.[2] The high-quality, low-cost system of photography which the reversal-film system offered was quickly adopted by amateurs and eventually found its way into extensive professional work. Although color films, also reversal-processed, now predominate in many 16mm applications, black-and-white materials affording a choice of high-speed types with excellent image quality have a well-established use in certain fields, including television, industrial work, recording and measuring, sports, etc.

In those cases where only the original film is required, the necessary laboratory service can be made available by installing processing equipment of a type ranging from the continuous automatic machines employed in custom processing plants to batch equipment with which the individual user can do his own work in order to get the quickest service, or for other reasons. In comparison with the negative-positive method which requires two precisely controlled processing systems and a printer, the reversal process needs little equipment and, once established, can be kept in control provided the customary attention is paid to agitation, times, temperatures, and bath composition. This control is possible because of the broad latitude in most of the processing steps.

This paper discusses the chemistry and the principles of operation in the processing of two Eastman reversal films recently made available to suit the needs of present-day usage. In 1949, Miller, Russell and Crabtree,[3] discussed the general subject of reversal processing with reference to the films then available and with emphasis on amateur use. The present paper, while following essentially the same treatment of the subject, differs both in respect to the film types involved and by the inclusion of continuous-machine methods in addition to batch-handling techniques.

Film Types and Requirements for Use

Films for present-day use, whether processed by the user or sent to a custom processing plant, must provide the choice of medium or high speed with excellent tone quality and image structure. In processing, they must lend themselves to handling in various types of equipment at normal and elevated temperatures with times in the processing baths and in drying that are often short in comparison with those prevailing in negative-positive work. Film for this purpose needs an emulsion coating hardened in manufacture and as thin as is consistent with the production of good image quality.

These requirements are met in the medium-speed range by Eastman Plus-X Reversal Film, Type 7276,* which has excellent fineness of grain and sharpness with exposure indexes of 40 for tungsten illumination and 50 for daylight; and, for difficult lighting situations, by the higher-speed Eastman Tri-X Reversal Film, Type 7278,† in which only the minimum concession is made in image structure in order to provide indexes of 160 for tungsten and 200 for daylight.

These films are designed to produce their optimum results when processed in identical baths in continuous machines of the types in most common use in custom processing laboratories. With most smaller batch-type apparatus, the two films can be treated with excellent results in a single system of baths chosen to suit the equipment.

Communication No. 1800 from the Kodak Research Laboratories, presented on April 30, 1956, at the Society's Convention at New York by C. E. Ives and N. A. Exley (who read the paper) of the Research Laboratories, and J. W. Zuidema and C. C. Wilt of the Film Testing Div., Eastman Kodak Co., Rochester 4, N.Y.

(This paper was received on September 11, 1956.)

* A similar product marketed under the name Cine-Kodak Plus-X Reversal Film requires identical processing.

† A similar product marketed under the name Cine-Kodak Tri-X Reversal Film requires identical processing.

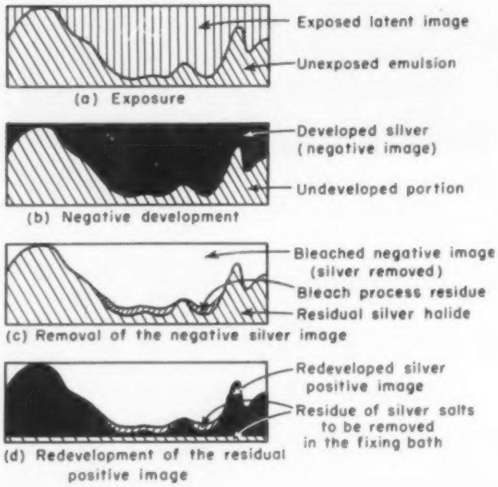

Fig. 1. The major steps in chemical reversal processing.

Mechanism of Reversal Processing

In processing a camera-exposed film to produce a negative as is usually done in 35mm motion-picture work, the exposed silver halide is developed to metallic silver and the undeveloped silver halide grains remaining are dissolved out in a hypo fixing bath. Reversal processing is designed to bring about the opposite effect. The silver image produced in a first development step is dissolved out in a bleach, leaving a complementary positive image which is developed to a full-tone metallic silver positive in a second developing bath. In this way, the negative and positive images are produced successively in the same emulsion layer. The inverse relationship between the negative and positive images is illustrated diagrammatically in Fig. 1, which shows the essential steps: (a) exposure to form a latent (negative) image; (b) development of the negative silver image; (c) removal of this image by bleaching; and (d) development of a positive silver image from the remaining silver halide grains.

In addition to the somewhat longer reversal processing procedure, this direct-positive photography requires specialized sensitive materials. Ordinary negative or positive films are generally unsuitable. A satisfactory reversal film must fulfill the requirements otherwise met by a separate negative with its high speed and color sensitivity and a positive with fine grain and detail-rendering power. However, with the proper combination of film and processing procedure, the management of the reversal process is simpler for the reason that, except for the first development, which must be held constant, the treatments either go to completion or reach a plateau region where the effect of changes in treatment is small. A fixed re-exposure is used in place of the difficultly gauged printing exposure required in negative-positive method. With present-day reversal films, scene-to-scene density control cannot be accomplished in processing by varying the re-exposure and is, therefore, solely in the hands of the cameraman.

Reversal photography is the preferred method when a single copy is needed. When a very few additional copies are required, prints are made directly by the use of special duplicating films intended for reversal processing. For best results, and, in any case, if many copies are to be made, a negative made by printing from the original positive is prepared for release printing use.

Processing Steps in the Reversal Process

The reversal process usually includes the successive steps of development, bleaching, clearing, re-exposure, redevelopment, fixing, washing, and drying. In some instances, a prebath is used before the first development, and rinse baths are used in most cases between chemical baths.

PREBATHS

In the batch-handling methods used in processing some earlier types of reversal films, the use of a formalin-carbonate hardening bath prior to first development was recommended.

With the new Plus-X and Tri-X reversal films, prehardening is unnecessary up to 95 F. However, the use of a nonhardening prebath is recommended in rewind-machine processing to assure uniform wetting at the start of development. Optimum fog control is attainable when an antifoggant is used in this prebath. Accordingly, a prebath formula (Kodak Prebath PB-3) containing 6-nitrobenzimidazole nitrate together with sufficient carbonate for maximum effect is given in the Formula Appendix.

FIRST OR NEGATIVE DEVELOPMENT

The first developer acts conventionally to reduce the exposed silver halide to form a silver negative image which appears dense and contrasty by usual standards. This quality results from the requirement that the silver halide in extreme highlight areas must be largely used up so as to yield very low densities in the reversed positive. At the same time, the character of the first developer must be such as to produce a long scale of tones from the highlights to the extreme shadows.

Films for reversal use ordinarily contain more silver than would be useful in forming an image of normal contrast and exposure scale. Some of the excess is eliminated because of two characteristics of the first developer. Ordinarily, the full first development given is accompanied by the production of a certain amount of chemical fog and, at the same time, some silver halide is removed by the solvent action of the sulfite preservative and by added silver halide solvents, such as sodium thiocyanate or hypo. These agents usually have the additional function of accelerating development.

Although the later steps in the reversal process can influence the general density level, the attainment of a satisfactorily low highlight density without other loss of quality is best obtained by the addition of silver halide solvent to the developer rather than by increasing first development time or modification of the other steps of the process. In Fig. 2, the effects of prolongation of development as against the addition of solvent are shown. It has been stated elsewhere[3] that the solvent acts to reduce density preferentially in the highlights because the residual undeveloped grains in such regions of

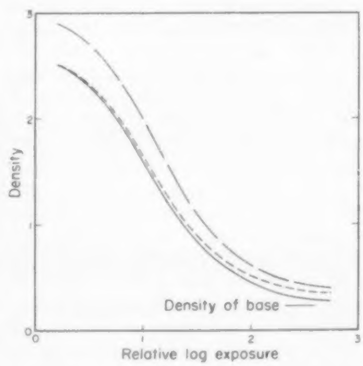

Fig. 2. Effect of first developer solvent on Eastman Tri-X Reversal Film, Type 7278. ———, normal first developer with thiocyanate, 2 min; — — —, first developer without thiocyanate, 2 min; – – – – – –, first developer without thiocyanate, 4 min.

high exposure are the smallest, least-sensitive ones which, because of their size, are dissolved most rapidly. The choice of solvent and its concentration must be carefully made but the maintenance of solvent action poses no great difficulty in replenishing.

The only developers suitable for use as first developers are of the high-contrast type because of the need for full development of the highlights without excessive density production in the shadows. Hydroquinone is always used, generally with the addition of a smaller proportion of Kodak Elon Developing Agent. The hydroquinone ranges from 30 grams/liter downward to 8 or 10 grams when Elon is also present. Elon ranges from 0.5 to several grams. Sulfite concentration may be as high as 90 grams/liter and is needed to avoid oxidation. For the most commonly required 2-min (68 F) first development, sodium hydroxide is used as the alkali.

Where the nature of the processing equipment calls for much longer development times, a pH of about 10.0 is usual (except with rewind equipment) and can be obtained with sodium carbonate. The choice of developer is also dictated, in part, by the response of various emulsion types in respect to contrast production, fog-susceptibility, and form of curve, as well as by peculiarities of equipment imposing a restriction on freedom of bath access such as exists with the rewind-type machines.

Because fogging in the first development tends to cause loss in shadow density of the reversed positive, fog restrainers are normally required. Potassium (or sodium) bromide is always used in the first developer with the addition in some cases of organic antifoggants such as 6-nitrobenzimidazole nitrate or benzotriazole for high temperature use. In rewind processing, fog control in first development is aided by the use of 6-nitrobenzimidazole nitrate in a prebath. Addition of antifoggant to the developer in greater concentrations than required to limit the fog production usually retards the development and may result in excessive density in the highlights of the positive.

Degree of Development

For the reasons given previously, the first development is usually carried at least to the point beyond which gamma and, therefore, picture contrast, are no longer increasing appreciably. At this point, with a suitable developer, it is also assured that the picture highlights of the reversal image will be satisfactorily low in density if the exposures are made at the normal exposure index. It will be noted in Fig. 3 that 50% over- and underdevelopment have resulted in a negligible variation in contrast. However, underdevelopment causes an increase in highlight density and some loss in speed while overdevelopment causes a general loss in density. In the latter case, graininess is also increased.

In reversal processing, the term "film speed" has two interpretations: (1) highlight speed, referring to the least exposure required to give clean, transparent highlights; and (2) emulsion speed, related to the least exposure required to produce satisfactory detail and tone gradation in the shadows. The latter is relatively less affected by change in the degree of development.

Thus, all three curves, A, B and C, of Fig. 3, representing the effect of 1, 2 and 3 minutes' first development with Plus-X Reversal Film, show about the same emulsion speed as indicated at the points of equal curve gradient, e, e′ and e″, in the shadow region. The exposure points for equal highlight gradient, h, h′ and h″, indicate considerable speed change. This type of speed gain as regards cases of extreme underexposure consists only slightly, if at all, in actual improvement of shadow-detail rendition but mainly in a reduction of density in the shadows so that, on projection, more detail can be seen in the region of underexposure. Figure 4 shows similar curves for Tri-X Reversal Film.

In regard to the highlights, selective development, scene by scene, could be used to compensate for the effects of exposure variation and so bring about a uniformity of projected image brightness, but the quality would fluctuate as a result of the accompanying shifts in maximum density. Of course, manipulation of this kind is not ordinarily practicable and would be considered only where it was imperative to salvage a scene that was known to be badly underexposed.

Except for the cases where special use of the film or extreme underexposure is the determining consideration, a maximum density of 2.3 to 2.6, including about 0.2 base density, is desired in order to produce the best screen quality. The choice of first developer and time of development is made with care to assure that a maximum density of this order is attainable without extraordinary difficulty in balancing the remaining steps in the process. Higher values are not usually obtained unless first development is insufficient, in which case highlight densities will also be too high and contrast may be too low. Maximum densities below 2.3 result when first development is greater than optimum or when for any reason excessive fog is present. While some control of maximum density, minimum density, and contrast can be exercised in other steps of the process, the effects of excessive or insufficient first development cannot be fully compensated for in the later steps and loss in quality is almost inevitable.

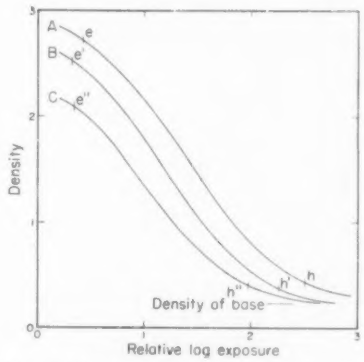

Fig. 3. Time of first development series, Eastman Plus-X Reversal Film, Type 7276. Curve A, 1 min; Curve B, 2 min; Curve C, 3 min.

Equipment and Choice of First Developer

The choice of first developer is influenced by the type of processing equipment used and the time of treatment which can be given. Thus, in some continuous machines, the film-path length in the first developer corresponds to several minutes' time at a running speed that is acceptable for the other stages of treatment. In such a case, a developer of medium activity with several grams per liter of thiocyanate is used. More frequently, developing time is only of the order of 2 min, and a more active Elon-hydroquinone caustic developer is used. The solvent concentration in the latter is about the same.

In rewind-type equipment, maximum developer activity is desirable to offset the severe retardation of development caused by the restriction in access of the bath to the film in the wound roll. However, the thiocyanate must be omitted because it tends to produce an increase in graininess, presumably because of

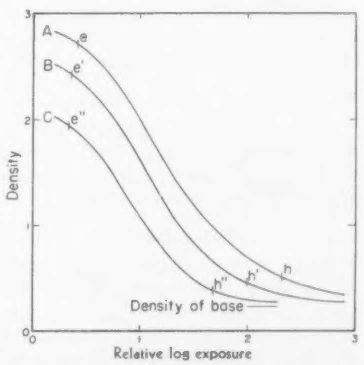

Fig. 4. Time of first development series, Eastman Tri-X Reversal Film, Type 7278. Curve A, 1 min; Curve B, 2 min; Curve C, 3 min.

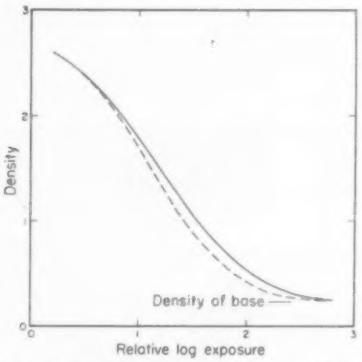

Fig. 5. Effect of bleach-bath composition on Eastman Plus-X Reversal Film, Type 7276. ———, for Kodak R-9; — — —, for bleach (16 grams per liter $K_2Cr_2O_7$ and 45 cc per liter of H_2SO_4).

attack on the smaller silver halide grains during the long time of contact with the bath necessitated by the equipment design. Good results are obtained with a caustic-hydroquinone developer, such as the Kodak Developer D-88. Formulas are suggested for the various types of equipment and operating practice in the Formula Appendix.

Elevated Temperature

Operation at temperatures as high as 95 F, without any prehardening treatment has given satisfactory results. In some cases, it may be necessary to add antifoggant to offset a tendency to increased fog. Although the two new films are well hardened in manufacture, further increase in temperature increases the possibility of mechanical damage, depending on the design of the equipment used and on the skill and care given to operation and maintenance. Also, the difficulty of controlling fog increases progressively with the temperature until a point is reached beyond which the attainment of top quality is not always possible. The developer formula and replenishment must be determined experimentally for each machine design and type of use and, in some instances, different formulas may be required for the two films.

Rinse Following First Development

A water-rinse bath should follow the first developer to reduce the carry-over to the bleach bath. An acid stop bath should not be used at this point.

BLEACHING

In the black-and-white reversal process, it is required that the bleach dissolve the metallic silver particles constituting the negative image produced in the first developer without affecting deleteriously the undeveloped silver halide. Bleach baths used for other purposes, such as the hypo-ferricyanide or the high bromide–ferricyanide types designed both to attack the silver and to dissolve silver halide, are therefore not suitable. Neither are those bleaches such as permanganate–bromide which convert silver to insoluble silver halide instead of removing it.

The bleaches useful in this process contain an oxidizing agent such as potassium permanganate or potassium dichromate and an acid such as sulfuric. They oxidize metallic silver to silver ion, which stays in solution at least until it can diffuse out of the gelatin layer. Only traces of bromide or chloride ions can be present; otherwise the silver will be converted to the insoluble halide and will not be removed.

Permanganate bleaches have had considerable use in the past but are difficult to control because of poor keeping and exhaustion properties and because they exert a complex influence on the re-exposure sensitivity which may affect tone reproduction.

Dichromate bleaches are usually preferred not only because of better performance in respect to these problems but also because they are capable of working faster, a feature which recommends them for use with several types of equipment in current use. However, with some dichromate bleach formulations and especially in some types of equipment, a residue is left in the highlight and lower-density regions which may appear as an excess minimum density or as a warm-colored stain. This residue containing chromium and silver is not very noticeable in the bleached film but usually contributes appreciable density after re-exposure and redevelopment.

The successful use of the dichromate bleach is dependent on the control of a series of steps, among which the rates of reaction and movement by diffusion of reactants and reaction products must be harmonized. The silver is first converted to silver ion which is in solution in the presence of the sulfate and dichromate ions. If the rate of formation of silver ion exceeds its rate of removal by diffusion from the gelatin emulsion layer into the bath, solubility limits are reached and solids are deposited which are not readily removable in the steps of the process preceding redevelopment. This imbalance occurs more readily in the bleaching of fine-grain images because the relatively great surface of small silver grains favors rapid reaction with the bath. The use of a bleach that is too concentrated for a particular film, especially when replacement of bath at the film surface is restricted as in a rewind-type processing machine, may cause the formation of the residues.

Since the stain material is a by-product of the silver bleaching process, it is present in greatest amount in the picture highlights which are the areas of greatest negative silver image density. Unfortunately, stains are most conspicuous in these areas in the final positive.

It has been reported previously that the degree of staining increases with the pH of the bleach bath, which may increase upon exhaustion.[3] A harmful degree of increase in pH should be avoided and is unnecessary with a proper rinse bath ahead of the bleach and adequate bleach replenishment. Recent experience has shown that the principal cause of the stain or spurious highlight density is the use of excessively strong bleaches for a given film in a particular handling technique, as discussed in a previous paragraph. For open-tank processing of any kind, the Kodak Bleaching Bath R-9 is generally best and the dichromate–sulfuric acid ratio which it embodies is suitable also for more concentrated bleaches which may be required in some instances for greater activity. Thus, while a triple-strength bath of this type can be used in order to save time in rewind processing of the Tri-X Reversal Film, Type 7278, the R-9 bleach should be diluted 1:4 to avoid highlight deposits when Plus-X Reversal Film, Type 7276, is handled in the same equipment. (See Formula Appendix.)

In continuous-machine or other open-tank processing with the R-9 bleach, the black silver of the image disappears in 15 sec to 1 min at 68 F, depending on the film type, the agitation employed, and the state of exhaustion of the bath. When excessive exhaustion is avoided, a bleaching time of 2 to 3 min is sufficient and should not be exceeded. Greatly excessive bleaching time, especially with more concentrated baths, depresses the sensitivity to re-exposure. With Plus-X Reversal Film, this sensitivity depression can cause a selective loss in the lower middletone densities and consequently excessive contrast as shown in Fig. 5, unless counteracted by a large increase in re-exposure, which may not be conveniently given and which introduces the risk of an undesirable general elevation of minimum density. When normal bleach concentration is maintained, no difficulty of this kind is encountered. The film path should provide no less than 2 min in the bleach at normal operating machine speed. Shorter times may result in insufficient bleaching after the bath is partly exhausted.

The Plus-X and Tri-X reversal films are hardened sufficiently in manufacture to resist successfully the softening tendency of the bleach bath at least up to 95 F, and it is recommended that sodium sulfate hitherto used in bleaches to suppress swelling be omitted.

CLEARING

Clearing consists in treatment of the bleached film in a sulfite solution which reduces the residual oxidizing compounds in the retained bleach as well

as by-products of the bleaching reaction to substances which leach out of the film in the clearing bath and in the rinse succeeding it. A sulfite concentration of 210 grams/liter is helpful in preventing stained highlights and should be used in all cases where the time of treatment can be kept down to 1 min at 68 F. Longer times of treatment with this bath cause some fixing out of the silver halide and consequent loss in the redeveloped density. This loss is serious with Plus-X Film in 5 min, as shown in Fig. 6. With batch processing, in which treating times as short as 1 min are not always convenient, a more dilute clearing bath is recommended (Kodak Clearing Bath CB-3, see Formula Appendix). The rate of attack on silver halide is reduced if the pH of the bath is lowered, as by substitution of bisulfite for part of the sulfite, but the effect of this acid solution on the redeveloper must be considered. The pH of the clearing bath can be 5.0 to 6.0. Attack on the silver halide is also diminished by the addition of a few grams of bromide per liter to the sulfite clearing bath.

Too short a clearing time should be avoided in order to prevent staining of the final image. Staining or other effects of faulty clearing can be judged only after processing is completed because residual compounds are often darkened in redevelopment.

The use of a water rinse between bleaching and clearing is generally desirable in order to minimize destruction of the sulfite by the carried-over bleach, although it can be omitted if replenishment of the clearing bath is increased.

Thorough washing with strong agitation and abundant water may, in some cases, be used successfully in place of the clearing bath, although usually it is simpler and surer to use the sulfite bath. The usual interstage rinse bath in most machines would be entirely inadequate for this extensive washing although it is satisfactory in its normal function of diluting the carried-over bleach.

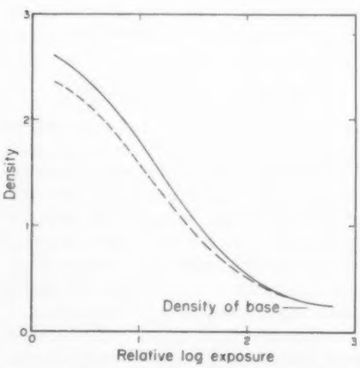

Fig. 6. Effect of clearing bath on Eastman Plus-X Reversal Film, Type 7276. ——— for 21% Na_2SO_3 and 1 min; — — —, for 21% Na_2SO_3 and 5 min.

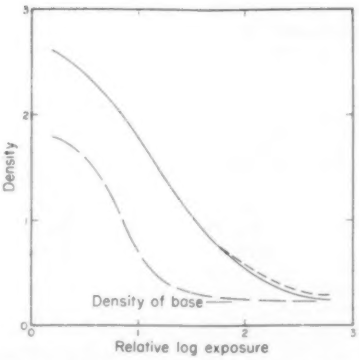

Fig. 7. Effect of re-exposure variations on Eastman Plus-X Reversal Film, Type 7276. - - - - - - - - -, re-exposure at 10,000 ft-c-sec; ———, re-exposure, at 100 ft-c-sec; — — —, re-exposure at 10 ft-c-sec.

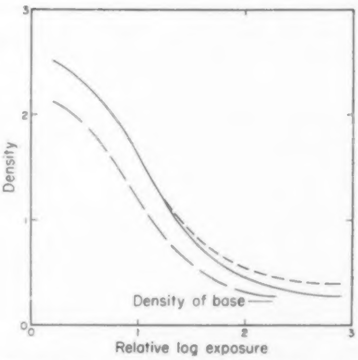

Fig. 8. Effect of re-exposure variations on Eastman Tri-X Reversal Film, Type 7278. - - - - - - -, re-exposure at 10,000 ft-c-sec; ———, re-exposure at 100 ft-c-sec; — — —, re-exposure at 10 ft-c-sec.

PRODUCTION OF THE POSITIVE IMAGE

After clearing, the film is rinsed and redeveloped. Redevelopment can be accomplished: (1) with conventional developers which usually require that the silver halide be exposed to light so as to form a developable latent image, or (2) with chemically fogging baths which convert the silver halide to a black silver image or to a silver compound of adequate density such as silver sulfide without requiring exposure to light.

Redevelopment Following Re-exposure

When re-exposure is used, the redeveloper may be any vigorous developer which completes its action in the time available under the existing equipment conditions. In general, a first developer which contains a powerful silver halide solvent such as thiocyanate or thiosulfate should not be used as redeveloper because the dissolution of silver halide may be so rapid as to cause a serious loss of maximum density and the production of dichroic fog. Developers such as Kodak D-19, D-72, or D-88 have been used successfully. Soft-working developers should not, in general, be employed to reduce contrast or modify curve shape, especially if the undesired quality is a result of faulty processing in a preceding step, as mentioned under the heading "Bleaching," above. It is sometimes desirable to add a small quantity of an antifoggant to the redeveloper to reduce stain and lower the minimum density. (Formulas are given in the Appendix.)

Re-exposure Levels

As mentioned in the introductory section, controlled re-exposure to compensate for error in camera exposure is not feasible with present-day films. Figures 7 and 8 show the effect of varying re-exposure with Plus-X and Tri-X Reversal Films, respectively. The normal re-exposure for these films is about 800 ft-c-sec, or 10 sec at 12 to 18 in. from a 60-w tungsten lamp. When the necessary illumination and time of exposure have been established to provide this level of exposure, large variations in either direction produce no noticeable effect on picture quality. The harmful effects of extreme over- or underexposure are therefore easily avoided.

An excess of re-exposure to the extent of more than 10 times may cause a slight increase in general density most noticeable in the projected picture as an undesirable increase in minimum density. A certain proportion of the silver halide grains fail to develop in either first or second developer and, unless re-exposure is grossly excessive, remains to be removed in the fixing bath with benefit to the picture quality.

A deficiency of re-exposure by a factor of 100 or more times tends to reduce the maximum picture density objectionably. However, this is not always a suitable way to reduce contrast and may even increase it by introducing complex tonal distortion of the type shown in Fig. 7. Also, when exposures are below the broad plateau region of correct re-exposure, more care is required to maintain constancy of quality.

Thus, the aim in re-exposure is to operate on the plateau region so as to obtain the full maximum density necessary for normal contrast and shadow quality without, however, bringing about complete development of the less sensitive and less readily developable material which would only raise minimum density to the detriment of highlight quality. Exposure levels should be checked by trial to make sure that no noticeable change in picture quality accompanies a 2 to 5 times change in re-exposure in either direction.

Table I. Suggested Process for Eastman Plus-X and Tri-X Reversal Films at 68 F. (Continuous-Machine Equipment)

Operation	Kodak Formula	Time (min)
1. First development . . .	D-94	2
2. Rinse	Running water. An acid stop bath must not be used at this point.	1
3. Bleach	R-9	2
4. Rinse	Running water	1
5. Clear	CB-2	1†
6. Rinse.	Running water	1
7. Re-exposure	About 800 ft-c-sec	
8. Redevelopment	D-95	1
9. Rinse.	Running water*	1
10. Fix.	F-10	1
11. Wash.	Running water	As required‡
12. Dry		

* An acid stop bath may be used in place of a water rinse following redevelopment, if desired. For this purpose, Kodak Stop Bath SB-1a is suggested.

† Times in excess of that shown should be avoided because of the tendency of this bath to dissolve the silver halide, with consequent loss of density in the positive image.

‡ The time of washing is determined by the efficiency of water application and the permissible residual hypo concentration for the intended use. (See ref. 5, following the text.)

Re-exposure can be applied at any point from the latter part of the clearing treatment to the early part of development. Exposure in the bleach is likely to be unsatisfactory because of depressed film-sensitivity at that stage. If re-exposure is given in the clearing bath, no additional time of contact with that bath should be entailed. If it is given while the film is in the redeveloper, sufficient time must be allowed subsequently for the redeveloper to complete its work. In rewind processing the re-exposure should be given while the film is being rewound in the rinse following clearing.

Fogging Redeveloper

Inasmuch as a considerable modification of tone reproduction is not ordinarily sought in redevelopment, this step would be simplified if it could be performed in all cases by the use of a fogging redeveloper. Unfortunately, no fogging redeveloper is known which offers the degree of preferential limitation of highlight density described in the preceding section, so that reliance must be placed on the re-exposure method for highest-quality results. Chemical fogging redevelopment methods are thus restricted to the cases where control of re-exposure is too difficult or where the disposition of the film in the equipment makes re-exposure impossible.

In these latter instances, the film must be removed from the equipment for re-exposure and then returned but this would complicate handling and involve added risk of physical damage to the film. To avoid this, a redevelopment scheme of a type which acts without need for light exposure is selected on the basis of what concessions can be made in regard to operational conditions and picture quality. Three basic types of baths are available: (a) the sulfide toners, (b) the nonselective inorganic reducers and (c) the conventional developers used with a nucleating or fogging agent.

Depending on the type of film to be redeveloped and the photographic purpose, it may be found possible to accept the brown or sepia-colored silver sulfide image produced by Kodak Sulfide Redeveloper T-19, or a caustic thiourea bath (1% thiourea, 2% sodium hydroxide), or any other toning bath which will convert the low-density residual positive silver halide into a full-density image of silver sulfide. The hue and effective density depend both on the choice of bath and on the type of film so that acceptability of the method must be determined by trial in accordance with the user's purposes. The silver halide is completely converted so that the desirable selective reduction of the minimum density obtainable with the re-exposure method is not possible here.

If the warm coloration characteristic of sulfiding is unacceptable, a nonselective inorganic reducing agent such as sodium stannite or alkaline hydrosulfite (dithionite) may be employed to produce a black image composed mainly of silver. Neither of these baths keeps well and they can be used only with care and ordinarily only in small-scale batch operations in which the solution can be prepared immediately before use. The stannite solution has an image-intensifying action and might be useful in special cases where it is known that excessive camera exposure or excessive first development has left too little silver halide to yield an adequate positive, but it is not a generally useful redeveloper. As in the sulfiding process, minimum density is not selectively controlled and may be higher than desired.

The third type of treatment consists in using conventional active developing solutions and securing the developability of the silver halide by the use of a fogging or nucleating agent either in the redeveloper or in a preceding bathing treatment.[4] These agents have an effect similar to light exposure in producing development centers or nuclei on the silver halide grains, which are then reducible to silver by the developer.

Nucleation may be effected by the use of such agents as thiourea, acetyl thiourea, methylene blue, phenyl thiosemicarbazide, hydrazine sulfate, and others. Kodak Fogging Developer FD-68 is an effective solution of this type containing hydrazine sulfate[4a] as the nucleating agent in a high pH Elon-hydroquinone developer of otherwise usual composition. Hydrazine sulfate is likewise effective, usually in a concentration of 1 or 2 grams/liter, as an addend to caustic developers such as Kodak D-8, D-88 or D-82. Redevelopment is virtually complete with Kodak FD-68 in 5 or 6 min. The image color is black but tone reproduction with some films is not acceptable for general use. (See Formula Appendix.)

FIXING

After redevelopment, the film is rinsed and then treated in an acid hardening–fixing bath. In the processes employing re-exposure, redevelopment leaves a small proportion of the silver halide grains undeveloped. Also, there may be deposited during processing, silver salts or other chromium compounds which would darken and discolor the highlights on keeping and exposure to light. One of the functions of the fixing bath is to dissolve these residues and thus effect a reduction of the minimum density and an improvement in highlight quality. While the Plus-X and Tri-X Reversal Films are able to withstand the severe softening influence of the reversal process, the hardening function of the fixing bath can be helpful in reducing swelling and thus diminishing the water load to be removed in drying. The effect upon drying is not noticeable with 68 F processing when the time in the other baths is not unnecessarily long.

RINSING AND WASHING

Water rinses can be used with benefit between the successive chemical processing baths to reduce contamination through chemical carry-over from one bath to the next. However, if water of satisfactory temperature and purity is not available, rinses can be omitted entirely except after the first developer where a good water rinse is necessary to prevent staining by reaction of developer with the bleach. An acid stop bath at this point is undesirable because, upon exhaustion, it tends to cause increased minimum density. In other steps when a rinse is omitted, it is sufficient to read-

just replenishment of the succeeding bath accordingly. A stagnant water rinse should not be used because carry-over gradually causes its composition to approach that of the preceding bath so that the effective time of treatment in that bath is prolonged and contamination of the succeeding bath is increased. Washing at the end of the process should be sufficient to reduce the residual hypo to the accepted level for camera-speed films in accordance with the degree of permanence required.[5]

AFTERTREATMENTS

The use of remedial aftertreatments such as reducers and intensifiers was discussed in a previous publication on reversal processing.[3]

DRYING AND LUBRICATING

The reversal films present no special squeegeeing or drying problems and can be handled successfully in any good, warm-air drying system. The best way to effect rapid drying is to impinge high-velocity warm-air streams against the film at short intervals. Radiant heat can be used but, as in other photographic practice, must be moderate in intensity and must be used only with rapid air flow so as to avoid embrittlement. After drying, the film should be lubricated by treatment with a wax solution.[6]

CAPACITY OF BATHS

In Table II tentative schedules for batchwise replacement and continuous replenishment of baths in continuous machines are shown. The exact formulas of replenishers and the rates of addition necessary to maintain uniform activity will depend on many factors, including the amount of film processed, aeration conditions during storage and use, and the use of rinse baths and interstage squeegees.

In reversal processing, it is even more important than in negative processing to maintain constant film speed, contrast and density since no opportunity exists for scene-to-scene quality matching other than that which can be done by competent camera work. The cameraman can succeed in this only when the laboratory work is dependably constant.

The simplest systems of bath maintenance to follow are those in which only the original bath formulas are used either on a batch-renewal basis or on a schedule of liberal replenishment which assures that the working bath will never depart much from the initial condition. To the extent that replenisher composition departs from the initial working formula, as in Table II, more careful control is necessary and the use of sensitometric testing and chemical analysis of baths becomes desirable.

The replacement of baths after every batch of film processed is advisable with

Table II. Suggested Bath Capacities and Bath Replenishment for Continuous-Machine Reversal Processing at 68 F, of Eastman Plus-X and Tri-X Reversal Films (16mm).

Bath	Kodak Formula	Useful capacity without replenishment (ft/gal)	Kodak Replenisher Formula	Replenishment rate (oz/100 ft)
First developer . . .	D-94	600	D-94R	7½
Bleach.	R-9	600	R-9R	1¾
Clearing bath. . . .	CB-2	1200	CB-2R	6¾
Redeveloper	D-95	1200	D-95R	2½
Fixing bath	F-10	1200	F-10R	3½

reel-and-trough, spiral reel and rewind devices.

As in other photographic work, due care should be exercised to avoid error in preparation of baths, contamination in handling or storage, and oxidation loss by excessive exposure to the atmosphere or by introduction of air in circulating systems.

PRACTICAL PROCESSING RECOMMENDATIONS

The foregoing discussion of the principles governing the reversal process are applicable to all types of handling, but no single set of bath formulas can be used for all types of equipment because of differences in the times of treatment and in the degree of agitation. The greatest proportion of reversal processing is done in continuous machines, but special requirements of some users dictate the use of batch equipment. The needs of batch equipment as against those of continuous machines determine, in part, the formulas of baths and the practice of replenishment. Some equipment, such as the rewind type, imposes special restrictions.

Continuous-Machine Handling

During the past several years, the number and variety of commercially available and custom-built continuous-processing machines has increased considerably so that recommendations can be given only along broad lines with the expectation that some adaptation will be made to suit the particular needs. Table I gives formulas and times of treatment for the various baths for typical equipment as used at 68 F. Except for the first development, the times given are more than the minimum and less than the maximum that can be used without untoward effect. Thus, for the most part, the bathing treatments and the re-exposure are operated in a plateau range in which considerable variation in time of treatment produces no significant change in results. The times given also represent a suitable proportioning of the times available among the various bathing treatments in ordinary machines.

As explained in an earlier section, the first or negative development must be stopped short of completion in order to obtain the optimum positive quality. Since the correct degree of development is a function of formula used and the state of the bath as well as the average intensity of agitation, the times given are approximate. There is some tolerance in the degree of development within which useful quality can be obtained, but fluctuations should be avoided so as to minimize quality variation and speed shift. With the remaining treatments operated in the plateau region of control as recommended, a range of times of first development should be tested, preferably under sensitometric control, and a level of first development selected which gives optimum quality and normal speed. The results of such a time-of-development series should be judged by the completely processed reversal image. Judgment of the correctness of first development by examination of the negative image should not be attempted.

Some degree of agitation such as is provided by immersed jets applied several times a minute is useful in the first development to minimize unevenness in density but it has a minor effect on the rate of development. Temperature of the first developer should be controlled to $\pm$ 0.5 F. In the remaining baths, variations of a few degrees can be tolerated.

The recommendations given in Tables I and III are based on the use of lively agitation in the bleaching treatment, such as strong, continuous air-bubbling. It is not recommended that this step be carried out without effective agitation. In the remaining steps of the process, agitation is optional. Although interstage squeegees are not ordinarily employed on reversal processing machines at running speeds up to 60 ft/min, their use helps to improve the efficiency of rinsing and lessens bath dilution.

Table III gives recommendations for operation at 95 F to provide normal picture quality and film speed. Elevation of temperature tends to give warmer image tone. While higher temperatures may be used successfully under favorable circumstances, no explicit recommendations can be made here. Even if machine design permits successful physical handling, increasing difficulty is

Table III. Suggested Process for Eastman Plus-X and Tri-X Reversal Films at 95 F. (Continuous-Machine Equipment)

Operation	Kodak Formula	Approx. time (sec)
1. First development	D-94	40
2. Rinse	Running water. An acid stop bath must not be used at this point.	20
3. Bleach	R-9	50
4. Rinse	Running water	20
5. Clear	CB-2	20†
6. Rinse	Running water	20
7. Re-exposure	About 800 ft-c-sec	
8. Redevelopment	D-95	20
9. Rinse	Running water*	20
10. Fix	F-10	30
11. Wash	Running water	As required‡

* An acid stop bath may be used in place of a water rinse following redevelopment if desired. For this purpose, Kodak Stop Bath SB-1a is suggested.

† Times in excess of that shown should be avoided because of the tendency of this bath to dissolve the silver halide, with consequent loss of density in the positive image.

‡ The time of washing is determined by the efficiency of water application and the permissible residual hypo concentration for the intended use. (See ref. 5 following the text.)

Table IV. Recommended Process for Eastman Plus-X and Tri-X Reversal Films at 68 F. (Reel-and-Trough or Rack-and-Tank Equipment)

Operation	Kodak Formula	Approx. time (min)
1. First development	D-94	2*
2. Rinse	Water. An acid stop bath must not be used at this point.	2
3. Bleach	R-9	3
4. Rinse	Water	1
5. Clear	CB-3	3†
6. Rinse	Water	1
7. Re-exposure	About 800 ft-c-sec‡	
8. Redevelopment	D-19	3
9. Rinse	Water§	1
10. Fix	F-6	5
11. Wash	Water	As required¶
12. Dry		

* Use about 2 min for Reel-and-Trough; 2½ min for Rack-and-Tank.

† Times in excess of that shown should be avoided because of the tendency of this bath to dissolve the silver halide, with consequent loss of density in the positive image.

‡ This exposure can be given to the film on a 15-in.-diameter reel in about ½ min by the use of an opal glass illuminator, fitted with 25-w tungsten lamps spaced 4 in. from each other and located 7 in. from the nearest point of approach of the film.

§ An acid stop bath may be used in place of a water rinse following redevelopment if desired. For this purpose, Kodak Stop Bath SB-1a is suggested.

¶ The time of washing is determined by the efficiency of water application and the permissible residual hypo concentration for the intended use. (See ref. 5 following the text.) Water can be run continuously or replaced after each step, and periodically during washing.

met in maintaining optimum quality as temperatures are raised.

Supplementary Hardening

If it becomes necessary to work with baths at temperatures above 95 F and it is found that, with available equipment and handling technique, additional hardening is needed, the use of Kodak Prehardener SH-5 (see Formula Appendix) may prove useful. Three minutes' treatment is sufficient, except with rewind equipment which requires 10 min. The antifoggant concentration should be increased to double the quantity given in the formula when necessary to suit operating conditions and strike an acceptable compromise between best quality and film speed.

When Prehardener SH-5 is used, the time of first development must be increased by about half as compared with that required when it is not used. The times in the remaining baths need not be changed to compensate for the effect of additional hardening.

Rapid Processing

As indicated by the difference in the times of treatment for the chemical baths in Tables I and III, elevation of temperature is useful in shortening the time required for processing. As a rule-of-thumb, the time required in a developer is reduced by about one-half for each increase in temperature of 15 F up to 95 F. The effect of temperature on the other chemical baths is not more than one-half as great as it is with developers. Rinsing can be shortened greatly by vigorous agitation, for example by spraying, coupled with sufficient flow of fresh water. The times shown in the tables are needed in ordinary equipment because of the prevalent lack of agitation and low rate of water renewal.

Reel-and-Trough Equipment

Formulas and times of treatment suitable for processing at 68 F with reel-and-trough equipment are given in Table IV. Kodak Clearing Bath CB-3 is recommended for this use in order to minimize the risk of density loss which might result from accidental over-long treatment time in the more concentrated CB-2. The plateau range of correct re-exposure provides so much latitude that uniform density is attainable by the usual technique of rotating the reel during re-exposure. For elevated temperatures, modifications in processing can be made in the same way as suggested for continuous-machine use.

Rack-and-Tank Equipment

Formulas and times of treatment suitable for use with rack-and-tank apparatus at 68 F are given in Table IV.

Spiral Reel

Reversal processing can be carried out by the use of spiral-reel equipment in which the film stands on edge during processing in the form of a flat spiral with a vertical axis. The film is held with convolutions about ⅛ in. apart by the spiral-equipment track and is therefore freely accessible to the baths but in some designs may be difficult to reach with the re-exposure illumination. Therefore, the baths recommended in Table IV can be used except that a fogging redeveloper may be needed. The alkaline hydrosulfite (dithionite) developer has been found acceptable but must be used exactly in accordance with the directions given with the formula because of its instability. (See Formula Appendix.)

Rewind Equipment

In rewind equipment, the film is wound back and forth between two reels immersed in the bath. Access of the bath to the film is restricted to such a degree as to require the use of some baths that are different from those used with other equipment and, in addition, much longer times of treatment. In order to ensure that the time of bath contact of all portions of the film will be alike in the critical stage of first development, a prebath is recommended. In contrast to the practice with some films formerly supplied, the prebath performs no hardening but contains an antifoggant which acts with singular advantage in controlling

first-developer fog. An energetic first developer is used but the thiocyanate solvent is omitted because it causes increased graininess under the conditions prevailing with this equipment. A bleach three times as strong as Kodak Bleach R-9 is used with Tri-X Reversal Film, Type 7278, but it is necessary to dilute the R-9 severalfold to avoid highlight residues with the finer-grain Plus-X Reversal Film, Type 7276. The clearing bath, fixer and redeveloper are of the usual types. Re-exposure should be performed while the film is being wound back and forth in the rinse following the clearing bath.

As is usual with other equipment, the time of first development should be determined by trial but the other treatments shown in Table V which apply to 100-ft rolls can be used as given. The processing time with this equipment depends on whether the emulsion is wound outward or inward in the reels, the latter providing somewhat less access of fresh bath to the film and therefore requiring somewhat longer times of treatment. For a similar reason, the time in any bath is also dependent on the length of roll. A 50-ft roll requires about 75% and a 25-ft roll about 50% of the time needed for a 100-ft roll. The rate of winding should be adjusted to provide a whole number of round trips in each bath so that all portions of the roll will have the same time of contact with the bath. Fresh solutions should be used for every roll processed. Running water should be used for the rinses and the final wash, or the water should be drained out and replaced after two passes, one in each direction of winding.

Table V. Recommended Process for Eastman Plus-X and Tri-X Reversal Films at 68 F. (Rewind Processing Equipment)

(For 100-ft rolls, with the film wound back and forth continuously at a rate sufficient to pass 100 ft of film from one reel to another in about 1 min. For 50-ft rolls, the times of treatment can be decreased to 75% of those given; and, for 25-ft rolls, to 50%.)

Operation	Kodak Formula	Approx. time (min)
1. Prebath	PB-3	4
2. Rinse	Water. An acid stop bath must not be used at this point.	4
3. First development	D-88	20 (Plus-X)
First development	D-88	18 (Tri-X)
4. Rinse	Water	4
5. Bleach	R-9 (1:4) (Plus-X)	40
Bleach	R-9 (3X) (Tri-X)	10
6. Rinse	Water	4
7. Clear	CB-1 (Plus-X)	10†
Clear	CB-2 (Tri-X)	20†
8. Rinse with simultaneous re-exposure, passing the film 8 times from one reel to the other while exposed to a No. 1 Photoflood lamp at 12 in.	Water	10
9. Redevelopment	D-88 + 0.25 gram/liter potassium iodide	10
10. Rinse	Water*	4
11. Fix	F-6	10
12. Wash	Water	40‡
13. Dry		

In rinsing and in washing, the water should either run into the tank continuously or be replaced after every two rewinding passes.

* An acid stop bath may be used in place of a water rinse following redevelopment if desired. For this purpose, Kodak Stop Bath SB-1a is suggested.

† Times in excess of those shown should be avoided because of the tendency of these baths to dissolve the silver halide, with consequent loss of density in the positive image.

‡ Or as required to reach acceptably low residual hypo concentration. (See ref. 5 following the text.)

Control of Quality

Once the correct degree of first development has been found by making any necessary adjustment to the suggested times, a uniform quality can be maintained with very little attention except to make the necessary additions of replenisher or to replace the baths after the specified amount of use. Sensitometric control provides the most complete information, but high-quality results can be obtained by the use of a simple densitometric checking. When the process is first set up with fresh solutions, samples of unexposed and completely flashed film of each type should be processed for later reference. A completely flashed film is one which has received a uniform light exposure great enough that no density difference can be detected when the exposure is doubled. The unexposed film will have a total density, including that of the gray support, of 2.3 to 2.6, while the completely exposed sample will have a density between 0.25 and 0.30. This densitometric check can be made routinely to detect changes in the process.

The following comments may be helpful in determining the cause of any departure from normal quality in the procedure employing re-exposure: In a sensitometric strip or a picture which is known to have correct exposure, if highlight and shadow densities are high, first development may be insufficient because of wrong time or temperature or exhaustion of the bath. If the highlight speed is abnormally high and the shadow density is low, excessive first development is probably the cause. However, if the highlights are normal and the shadow density is low, the cause may be light-fog or unusual chemical fog occurring in the first development. Lack of redevelopment can also cause loss of contrast and maximum density. This can be checked by cutting out a piece of the film after re-exposure and giving it normal redevelopment in a fresh sample of bath. Lack of re-exposure can cause a similar effect but only when it is so great as to be readily detected by other means. Loss of maximum density when baths are in good condition and when quality is otherwise normal may be caused by attack on the silver halide in the clearing bath, for example, by excessively long treatment in a strong sulfite bath.

Excessive re-exposure has to be enormous to produce a noticeable effect in increasing highlight density. Exposure to the general artificial room-lighting during clearing and all subsequent baths in continuous-machine processing is usually without noticeable effect if the normal re-exposure is also given.

Excessively dense and discolored highlights may result from inadequate clearing, but they usually indicate trouble in the bleach caused by lack of rinsing between first developer and bleach or by using a bleach of improper composition. Bleach exhaustion can cause dense highlights, usually in a somewhat streaky pattern. The black silver image should disappear by the halfway point in the bleach treatment.

Correction of deviations from normal quality should be made by discovering the cause and eliminating it; not by adopting compensatory measures elsewhere in the process. If in doubt, it is usually best to replace a bath which is not performing properly. While reliance is placed on a rather complex interdependence of various steps in the process, routine production of high quality is readily achieved.

Processing to Produce a Negative

Eastman Plus-X and Tri-X Reversal Films, although designed for reversal processing, are capable of yielding useful negative images of conventional quality

and contrast if developed in a soft-working bath such as Kodak Developer D-76, and then fixed. When a developer of this type is used, the speed is not more than one-half that normally obtained in the reversal processing, which always involves the use of a vigorous developer and forced first development.

If negatives are required, it is preferable in all respects to use films designed solely for the purpose.

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FORMULA APPENDIX

With some types of equipment, manipulation of the film while it is laden with processing solutions is necessary to take up slack and prevent overlapping. It is recommended that goggles, rubber gloves and protective clothing be used, especially with the developers containing sodium hydroxide and with the bleaches.

Kodak Prebath PB-3

	Avoirdupois— U.S. Liquid	*Metric*
Water	115 oz	900.0 cc
*0.5% solution of Kodak Anti-Fog No. 2 (6-Nitrobenzimidazole Nitrate)	16 drams	16.0 cc
Kodak Sodium Carbonate, monohydrated	2 oz	15.0 grams
Water to make	1 gal	1.0 liter

* To prepare a 0.5% solution, dissolve 18 grains of Kodak Anti-Fog No. 2 in 8 oz of distilled water (1 gram in 200 cc of water).

Kodak Developer D-94

	Avoirdupois— U.S. Liquid	*Metric*
Water, about 70 F (21 C)	96 oz	750.0 cc
Kodak Elon Developing Agent	35 grains	0.6 gram
Kodak Sodium Sulfite, desiccated	6¾ oz	50.0 grams
Kodak Hydroquinone	2 oz 290 grains	20.0 grams
Kodak Potassium Bromide	1 oz 30 grains	8.0 grams
or Sodium Bromide	400 grains	7.0 grams
Kodak Sodium Thiocyanate	350 grains	6.0 grams
Kodak Sodium Hydroxide	2 oz 290 grains	20.0 grams
Water to make	1 gal	1.0 liter

Dissolve chemicals in the order given.

Kodak Replenisher D-94R
(For Use with Kodak Developer D-94)

	Avoirdupois— U.S. Liquid	*Metric*
Water, about 70 F (21 C)	96 oz	750.0 cc
Kodak Elon Developing Agent	75 grains	1.3 grams
Kodak Sodium Sulfite, desiccated	6¾ oz	50.0 grams
Kodak Hydroquinone	3½ oz	26.0 grams
Kodak Sodium Thiocyanate	1 oz	7.5 grams
Kodak Sodium Hydroxide	4½ oz	34.0 grams
Water to make	1 gal	1.0 liter

Dissolve chemicals in the order given.

Kodak Developer D-95

	Avoirdupois— U.S. Liquid	*Metric*
Water, about 70 F (21 C)	96 oz	750.0 cc
Kodak Elon Developing Agent	60 grains	1.0 gram
Kodak Sodium Sulfite, desiccated	6¾ oz	50.0 grams
Kodak Hydroquinone	2 oz 290 grains	20.0 grams
Kodak Potassium Bromide	290 grains	5.0 grams
or Sodium Bromide	260 grains	4.5 grams
Kodak Potassium Iodide	15 grains	0.25 gram
Kodak Sodium Hydroxide	2 oz	15.0 grams
Water to make	1 gal	1.0 liter

Dissolve chemicals in the order given.

Kodak Replenisher D-95R
(For Use with Kodak Developer D-95)

	Avoirdupois— U.S. Liquid	*Metric*
Water, about 70 F (21 C)	96 oz	750.0 cc
Kodak Elon Developing Agent	130 grains	2.2 grams
Kodak Sodium Sulfite, desiccated	6¾ oz	50.0 grams
Kodak Hydroquinone	6¾ oz	50.0 grams
Kodak Sodium Hydroxide	6¾ oz	50.0 grams
Water to make	1 gal	1.0 liter

Dissolve chemicals in the order given.

Kodak Developer D-19

	Avoirdupois— U.S. Liquid	*Metric*
Water, about 125 F (50 C)	64 oz	500.0 cc
Kodak Elon Developing Agent	115 grains	2.0 grams
Kodak Sodium Sulfite, desiccated	12 oz	90.0 grams
Kodak Hydroquinone	1 oz 30 grains	8.0 grams
Kodak Sodium Carbonate, monohydrated	7 oz	52.5 grams
Kodak Potassium Bromide	290 grains	5.0 grams
Cold water to make	1 gal	1.0 liter

Dissolve chemicals in the order given.

Kodak Fogging Developer FD-70

	Avoirdupois— U.S. Liquid	*Metric*
Part A		
Sodium Dithionite (90%)* (Hydrosulfite)	290 grains	5.0 grams
Part B		
Water	115 oz	900.0 cc
Kodalk Balanced Alkali	1 oz 145 grains	10.0 grams
2-Thiobarbituric Acid**	30 grains	0.5 gram
Water to make	1 gal	1.0 liter

Dissolve 290 grains of Part A in 1 gallon of Part B (or 5 grams in 1 liter) not more than 2 hours before use. Discard after one use. Redevelop the film for 5 min at 70 F.

* Available as Eastman Organic Chemical No. P 533.

** Available as Eastman Organic Chemical No. 660.

Caution: The Kodak Fogging Developer FD-70 contains compounds that are extremely active photographically. If the dry powder comes into contact with photographic materials, serious spotting may occur. Care must be exercised therefore to prevent the powder suspended in the air from reaching photographic materials or areas where they are handled. Likewise, the hands and the containers used for mixing and use of this solution should be thoroughly cleaned by washing.

Kodak Developer D-88

	Avoirdupois— U.S. Liquid	*Metric*
Water, about 125 F (50 C)	96 oz	750.0 cc
Kodak Sodium Sulfite, desiccated	6 oz	45.0 grams
Kodak Hydroquinone	3 oz	22.5 grams
Kodak Boric Acid, crystals*	¾ oz	5.5 grams
Kodak Potassium Bromide	145 grains	2.5 grams
Kodak Sodium Hydroxide (Caustic Soda)	3 oz	22.5 grams
Cold water to make	1 gal	1.0 liter

* Crystalline boric acid should be used as specified. Powdered boric acid dissolves only with great difficulty, and its use should be avoided.

Dissolve chemicals in the order given.

Kodak Bleaching Bath R-9

	Avoirdupois—U.S. Liquid	Metric
Water	1 gal	1.0 liter
Kodak Potassium Dichromate	1¼ oz	9.5 grams
Sulfuric Acid, concentrated*	1½ fluid oz	12.0 cc

* *Caution:* Always add the sulfuric acid to the solution slowly, stirring constantly, and never the solution to the acid; otherwise, the solution may boil and spatter the acid on the hands or face, causing serious burns.

Kodak Replenisher R-9R
(For Use with Kodak Bleaching Bath R-9)

	Avoirdupois—U.S. Liquid	Metric
Water	1 gal	1.0 liter
Kodak Potassium Dichromate	10⅔ oz	80.0 grams
Sulfuric Acid, concentrated*	2¾ fluid oz	22.0 cc

* *Caution:* Always add the sulfuric acid to the solution slowly, stirring constantly, and never the solution to the acid; otherwise, the solution may boil and spatter the acid on the hands or face, causing serious burns.

Kodak Clearing Bath CB-1

	Avoirdupois—U.S. Liquid	Metric
Water	96 oz	750.0 cc
Kodak Sodium Sulfite, desiccated	12 oz	90.0 grams
Water to make	1 gal	1.0 liter

Kodak Clearing Bath CB-2

	Avoirdupois—U.S. Liquid	Metric
Water	96 oz	750.0 cc
Kodak Sodium Sulfite, desiccated	1¾ lb	210.0 grams
Water to make	1 gal	1.0 liter

Kodak Replenisher CB-2R
(For Use with Kodak Clearing Bath CB-2)

	Avoirdupois—U.S. Liquid	Metric
Water	96 oz	750.0 cc
Kodak Sodium Sulfite, desiccated	2 lb	240.0 grams
Water to make	1 gal	1.0 liter

Kodak Clearing Bath CB-3

	Avoirdupois—U.S. Liquid	Metric
Water	96 oz	750.0 cc
Kodak Sodium Sulfite, desiccated	1 oz 145 grains	10.0 grams
Water to make	1 gal	1.0 liter

Kodak Stop Bath SB-1a

	Avoirdupois—U.S. Liquid	Metric
Water	1 gal	1.0 liter
Kodak Acetic Acid, 28%,* *OR*	16 oz	125.0 cc
Kodak Glacial Acetic Acid	3¾ oz	30.0 cc

* To make approximately 28% acetic acid from glacial acetic acid, dilute 3 parts of glacial acetic acid with 8 parts of water.

Kodak Fixing Bath F-6

	Avoirdupois—U.S. Liquid	Metric
Water, about 125 F (50 C)	80 oz	600.0 cc
Kodak Sodium Thiosulfate (Hypo)	2 lb	240.0 grams
Kodak Sodium Sulfite, desiccated	2 oz	15.0 grams
Kodak Acetic Acid, 28%,* *OR*	6 oz	48.0 cc
Kodak Glacial Acetic Acid	1¾ oz	13.0 cc
Kodalk Balanced Alkali	2 oz	15.0 grams
Kodak Potassium Alum	2 oz	15.0 grams
Cold water to make	1 gal	1.0 liter

* To make approximately 28% acetic acid from glacial acetic acid, dilute 3 parts of glacial acetic acid with 8 parts of water.

Dissolve chemicals in the order given.

Kodak Fixing Bath F-10

	Avoirdupois—U.S. Liquid	Metric
Water, about 125 F (50 C)	64 oz	500.0 cc
Kodak Sodium Thiosulfate (Hypo)	2¾ lb	330.0 grams
Kodak Sodium Sulfite, desiccated	1 oz	7.5 grams
Kodalk Balanced Alkali	4 oz	30.0 grams
Kodak Acetic Acid, 28%,* *OR*	9 oz	72.0 cc
Kodak Glacial Acetic Acid	2½ oz	20.0 cc
Kodak Potassium Alum	3 oz	22.5 grams
Water to make	1 gal	1.0 liter

* To make approximately 28% acetic acid from glacial acetic acid, dilute 3 parts of glacial acetic acid with 8 parts of water.

Dissolve chemicals in the order given.

Kodak Replenisher F-10R
(For Use with Kodak Fixing Bath F-10)

	Avoirdupois—U.S. Liquid	Metric
Water, about 125 F (50 C)	64 oz	500.0 cc
Kodak Sodium Thiosulfate (Hypo)	3½ lb	420.0 grams
Kodak Sodium Sulfite, desiccated	1 oz 145 grains	10.0 grams
Kodalk Balanced Alkali	4 oz	30.0 grams
Kodak Acetic Acid, 28%*, *OR*	15½ oz	120.0 cc
Kodak Glacial Acetic Acid	4¼ oz	33.0 cc
Kodak Potassium Alum	3 oz	22.5 grams
Water to make	1 gal	1.0 liter

* To make approximately 28% acetic acid from glacial acetic acid, dilute 3 parts of glacial acetic acid with 8 parts of water.

Dissolve chemicals in the order given.

Kodak Prehardener SH-5

	Avoirdupois—U.S. Liquid	Metric
Solution A		
Kodak Formaldehyde, about 37% solution by weight	5 drams	5.0 cc
Solution B		
Water	115 oz	900.0 cc
0.5% solution of Kodak Anti-Fog No. 2* (6-Nitrobenzimidazole Nitrate)	5 oz	40.0 cc
Kodak Sodium Sulfate, desiccated	6¾ oz	50.0 grams
Kodak Sodium Carbonate, monohydrated	1 oz 260 grains	12.0 grams
Water to make	1 gal	1.0 liter

* To prepare a 0.5% solution, dissolve 18 grains of Kodak Anti-Fog No. 2 in 8 ounces of distilled water (1 gram in 200 cc of water).

Directions for Mixing: The working solution should be prepared just before use, by adding 5 drams of Solution A to 1 gal of Solution B (5 cc of A to 1 liter of B) and mixing thoroughly.

Kodak Fogging Developer FD-68

	Avoirdupois—U.S. Liquid	Metric
Water, about 125 F (50 C)	64 oz	500.0 cc
Kodak Elon Developing Agent	115 grains	2.0 grams
Kodak Sodium Sulfite, desiccated	12 oz	90.0 grams
Kodak Hydroquinone	1 oz 30 grains	8.0 grams
Kodak Sodium Carbonate, monohydrated	7 oz	52.5 grams
Kodak Sodium Hydroxide	1 oz 145 grains	10.0 grams
Hydrazine Sulfate*	60 grains	1.0 gram
Water to make	1 gal	1.0 liter

* *Caution:* Hydrazine sulfate is a skin irritant. Keep the powder or solution away from the skin or eyes. If contact does occur, wash with plenty of water immediately. Wear rubber gloves and an apron while working with this formula.

Dissolve chemicals in the order given.

A New 16mm Camera Color Film for Professional Use

By JOHN L. FORREST

Anscochrome Professional Film, Type 242, is a soft gradation reversible camera film for professional use. Duplicate prints from this new film on Type 238 Duplicating Stock can be made which approach original quality. The film is balanced for 3200 K and has an Exposure Index of 10. It is processed in the laboratories of the manufacturer.

A PAPER on reversal Anscochrome for motion-picture use was presented at the October 1955 Convention of the Society.[1] It described a film intended for exposure in the camera and projection of the reversal positive therefrom. This film was intended mainly for direct projection and not as an original for printing. However, it was learned that excellent prints can be made from it on Ansco Color Duplicating Stock.

A soft gradation version of the product called Anscochrome* Professional Film has now been developed. Anscochrome Professional is a 16mm camera film which, when processed by the reversal technique, produces a soft gradation positive intended for printing on Ansco Color Type 238 Duplicating Stock.

In structure (Fig. 1), the film is of the multilayer type in classical tripack formation. The lower layer of the three light-sensitive layers is sensitive to red, the middle layer is sensitive to green and the top layer records the blue. A dischargeable yellow filter layer, which holds back the blue light from the under layers and insures good color separation, separates the top layer from the second layer.

All the emulsion layers are coated over a dark colloidal silver antihalation coating applied directly on the safety base.

Colorless dye formers producing color complementary to the sensitivity of each layer are incorporated in the layers during manufacture. The blue-sensitive layer forms the yellow image, the green-sensitive layer produces magenta, and the red-sensitive layer develops cyan. This well-known system of color formation simplifies the processing technique to the extent that a single color developer forms, simultaneously, the desired color in each of the three layers.

Characteristic curves of the film are shown in Fig. 2. It will be seen that the film has a long straight line characteristic with particular softness in the toe. For a projection material, this would produce a flat, unpleasant characteristic. However, it must be remembered that in every photographic printing technique, the build-up of contrast presents a problem and Anscochrome Professional has been designed so that a color duplicate print that has qualities nearly approaching an original can be produced from it. It will be noted that while the film has a soft toe characteristic, it also has a high shoulder. This is necessary in order to preserve gradation and shadow detail.

Evaluation of the spectral transmission characteristics of the dyes used in Anscochrome Professional must be made in relation to their printing density on the printing stock (Fig. 3).[2] The sensitometric curves were plotted from readings made with a color densitometer and therefore, while being relatively correct in relation to the reading filters, do not show the same gamma relation when printed on the 238 Type Duplicating Stock.[3]

Reproduction curves (Fig. 4) were made by printing a sensitometric strip of Anscochrome Professional on duplicating film Type 238 using a Bell & Howell Model J printer. These curves represent the color values obtained in the print-through. It will be noted that the contrast increase inherent in the process has been completely offset by the soft gradation of the original, so that the resulting reproduction is smooth, without excessive contrast in the shoulder, and without loss of gradation in the toe which ordinarily results in washed-out highlights.

Since most commercial work is done in artificial light, Anscochrome Professional has been balanced to 3200K and produces well-balanced pictures when exposed under this condition. For exposure in daylight, a Kodak Wratten Filter No. 83 provides satisfactory correction (Table I). When exposed with tungsten light, pictures of satisfactory density are secured at an Exposure Index of 10. The use of the Wratten No. 83 filter in daylight reduces speed slightly and, under these conditions,

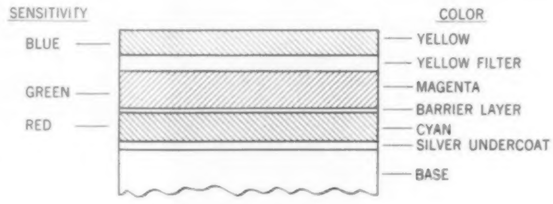

Fig. 1. Ansco Professional Camera Film Type 242.

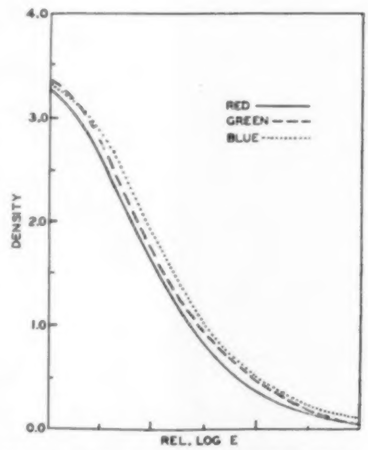

Fig. 2. Characteristic curve for Anscochrome Professional Type 242.

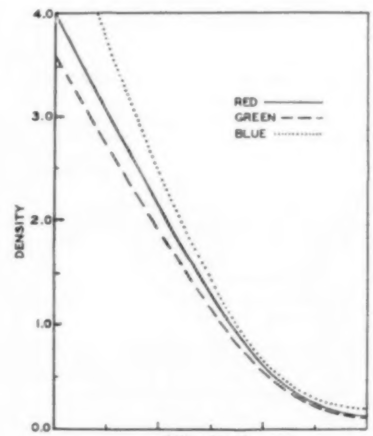

Fig. 3. Characteristic curve of Ansco Color Duplicating Film Type 238.

Presented on October 9, 1956, at the Society's Convention at Los Angeles by Harold Jones who read the paper for the author, John L. Forrest, Motion Picture Development Laboratory, Ansco, Binghamton, N.Y.
(This paper was received on October 8, 1956.)

* Trademark of the General Aniline & Film Corp.

Table I. Light Source and Filters Required

Light source	Filter for light sources	Filter for camera (Kodak Wratten)
3200 K tungsten lamps	None	None
Photoflood lamps	None	81A
CP lamps (approx. 3350 K)	None	81A
Carbon Arcs	Strawcolored	
M.R. Type 170, 150-amp. H.I. Arc	Filter such as Brigham Y-1	83
MR. Type 40, 40-amp. Du-Arc	Florentine Glass	83
Daylight	None	83

an Exposure Index of 8 is recommended. Other light sources can be used successfully if a suitable filter is used to bring them within the working range of the film.

A perfect balance from the visual standpoint is not necessary, since it is the color duplicate print which is exhibited and as long as the recorded color images are exposed within the working range of the individual layers, any normal variation can be corrected by the use of the basic filter pack on the printer. It is essential, however, that the entire production be exposed to the same illumination balance; otherwise, printing may require changes in the filter pack.

Like all photographic emulsions, certain variations between emulsions of different age are inevitable; therefore it is recommended that sufficient footage of the same emulsion number be secured to complete the production. This will obviate the necessity of making corrections in filtration for emulsion variations and enhance the uniformity of the finished production.

It should be remembered that Anscochrome Professional is intended to be used as a camera film where color duplicate prints are required, and for this purpose, the usual practice is to expose the original to produce somewhat more dense pictures than would normally be considered correct for reversal film used for direct projection. The light contrast should be kept in the order of 1 : 2 and not to exceed 1 : 3 keylight to fill-light, in order to prevent burning out the highlights. This follows general professional practice and is easily accomplished in studio work. For outdoor work, supplemental lights, suitably corrected for color temperatures, or reflectors, can be used satisfactorily to keep the lighting ratio within the suggested range.

Since the film is not intended for single-system sound recording, it is available only with ASA Silent Perforations in roll lengths of 100, 200 and 400 ft.

While awaiting processing, the film should be stored in a cool dry place. The temperature should be below 70 F and the relative humidity around 40%. The film need not be refrigerated. However, if the film must be stored for some time before use, refrigerated storage will preserve the original characteristics of the film for a longer time. If refrigerated

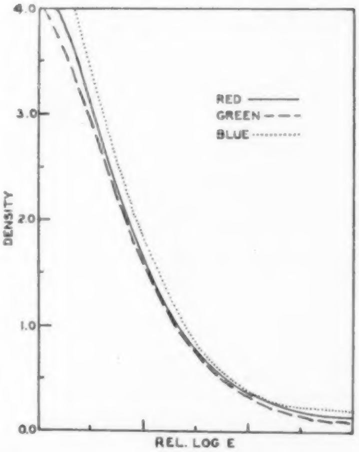

Fig. 4. Print-through curve on Ansco Duplicate Film Type 238, printed from Type 242 Original.

storage is used, the usual precautions for removal, warm-up, and acclimation before use should be followed.

After exposure, it is desirable to process the film as soon as possible. For the time being, the product is sold with processing included in the purchase price and will be processed at the Ansco Processing Laboratories.

References

1. J. L. Forest, "Processing Anscochrome Motion Picture Film for industrial and scientific applications," *Jour. SMPTE,* **60:** 679–681, Dec. 1955.
2. Report of Color Sensitometry Committee, *Jour. SMPTE,* **54:** 653–724, June 1950.
3. K. G. Macleish, "A transmission densitometer for color film," *Jour. SMPTE,* **60:** 696–708, June 1953.

A Method Using Dielectric Heating for Splicing Motion-Picture Film

By R. W. UPSON, EMERY MESCHTER and W. R. HOLM

A practical way of achieving a new high level of splicing strength and performance on motion-picture film is described. The apparatus depends on dielectric heating for its operation. The method does not use cement, but it provides durable and highly reliable splices needing only a very small overlap area. The method should be adaptable to many different splicers.

A SPLICING TECHNIQUE based on the use of pressure-sensitive tape made from "Mylar" polyester film was described at the Society's 1954 Fall Convention.* Splices so produced had certain unique qualities and the method had the added advantage of speed and simplicity of operation. These splices represented one phase of a larger program to develop a new polyester photographic film base which has been trademarked "Cronar". This base was described at the Society's 1955 Fall Convention.† The chemical inertness of Cronar makes solvent splicing very difficult, and the best splices attainable by conventional techniques left much to be desired. Continued work on new methods for splicing this polyester base film has been successful and has led to a splicing technique which is apparently valuable in its own right.

The new splice depends on dielectric heating for its formation. It uses no cement or adhesive, yet is highly reliable and requires only a very small overlap area. It is permanent and as insensitive to moisture and temperature as the film itself. The projection life of these splices is unusually long.

Heat-sealing and splicing of plastic materials, including films, are commercially employed in many fields, and apparatus and procedures have been disclosed in many patents.‡ However, this seems to be the first time the method described here has been used in motion-picture practice.

New Method

The essentials of the new method are shown schematically in Fig. 1. The films F to be joined are held between splicer jaws J. Inserted in the end of each of these jaws is an electrode E. These electrodes, together with the films to be spliced, form part of the circuit of a high-frequency oscillator O. Energizing the circuit causes a high-frequency current to flow between the electrodes through the region R, heating the films to the point of fusion in about one second. Warping and weakening of the films is avoided, since heating is concentrated at the joint itself. Dielectric weld splices reach their ultimate strength before the film can be removed from the jaws of the splicer, so no "dwell" or holding time is required. The dielectric technique has a further advantage in that the operation is substantially independent of operator skill.

A lumped constant schematic diagram of the oscillator circuit is shown in Fig. 2. A type 826 triode tube is connected as a tuned grid-tuned cathode oscillator, with the series resonant load circuit tapped across the cathode as shown. Pushing a button on the oscillator box applies the B+ voltage to the tube plate. The tube begins to conduct, oscillating at a frequency of 230 mc. The series resonant circuit, of which the two electrodes and the films to be spliced constitute the capacitative reactance, appears as a low-impedance shunt across the cathode circuit and a large radio-frequency current flows as indicated by the solid curve in Fig. 3.

It can be shown that splice formation begins just on the inductive (X_L) side of resonance. As the film heats up and melts, the spacing between the electrodes decreases. This causes an increase in the capacitance of the condenser formed by the two electrodes and the film dielectric. The circuit thus passes through resonance and over to the capacitative (X_C) side. This detunes it sufficiently to present a relatively high impedance and so essentially shuts off the current flow in the splice.

Presented on October 9, 1956, at the Society's Convention at Los Angeles by R. W. Upson, Emery Meschter and W. R. Holm (who read the paper), Photo Products Dept., E. I. du Pont de Nemours & Co., Inc., Parlin, N. J.

(This paper was received on November 5, 1956.)

* V. C. Chambers and W. R. Holm, "A method for splicing motion-picture film," *Jour. SMPTE, 64*: 5–8, Jan. 1955.

† D. R. White, C. J. Gass, E. Meschter and W. R. Holm, "Polyester photographic film base," *Jour. SMPTE, 65*: 674–678, Dec. 1955.

‡ U.S. Patents: Pitman, 2,087,480, July 20, 1937; Keller, 2,179,261, Nov. 7, 1939; Steimel, 2,205,-582, June 25, 1940; Strickland, 2,354,714, Aug. 1, 1944; Lawrence, 2,410,222, Oct. 29, 1946; Anderson, et al., 2,583,133, Jan. 22, 1952.

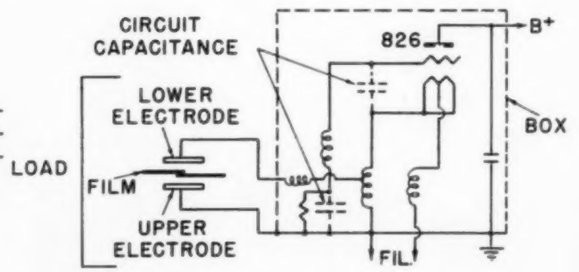

Fig. 2. Lumped constant schematic of 230-mc oscillator for dielectric splicer.

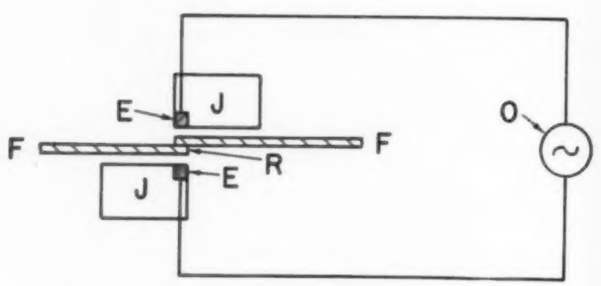

Fig. 1. Schematic of dielectric splicer.

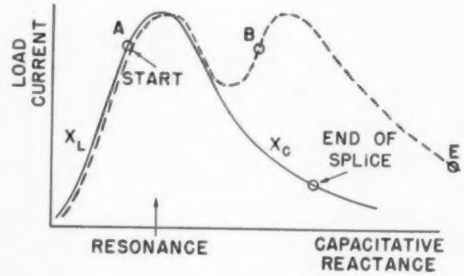

Fig. 3. Current flow during dielectric splicing.

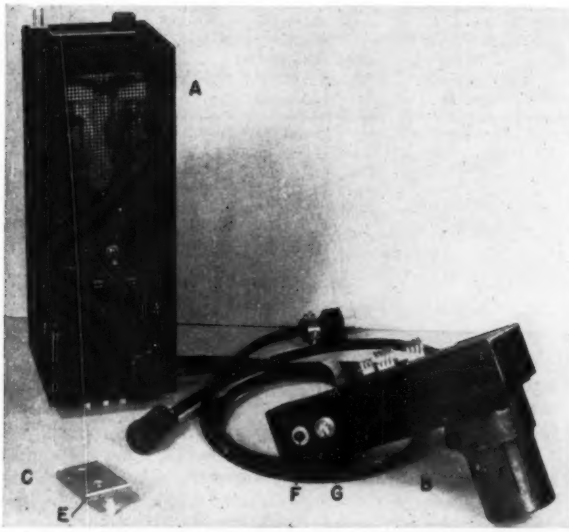

Fig. 4. Chief electrical components of dielectric splicer: A, power supply; B, oscillator; C, lower plate; E, electrode; F, energizing switch; G, indicator lamp.

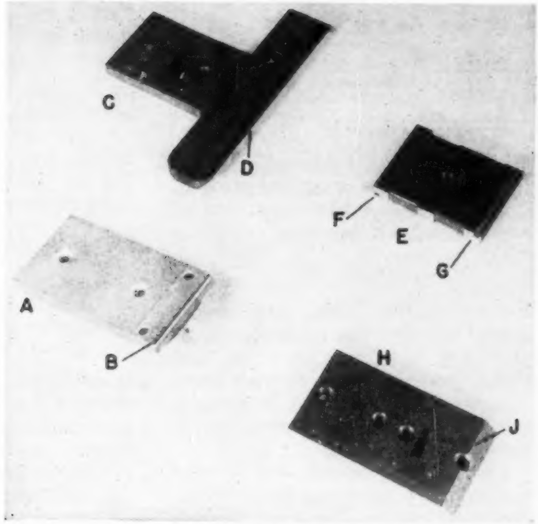

Fig. 5. Plates for dielectric splicer: A, lower left plate with embedded electrode B; C, upper left plate with bevelled edge D; E, upper right plate with insulating channels F and G; H, lower right plate with bevelled edge J.

The practical requirement of splicing both 4.0 and 5.5 mil base on the same apparatus without individual adjustment gives rise to the more complex situation represented by the broken curve of Fig. 3. Closer coupling of a resonant circuit such as this can produce more than one resonance peak. The circuit resonates over a wider range of capacitance, or, in this case, over a wider range of film thickness in the splicer jaws. Current flow and film heating can occur starting anywhere in the range A to B, and the end of the heating cycle now moves to E. The automatic cut-off of heating current upon splice completion still takes place.

This cut-off feature makes it impossible to overheat or burn the film. It is used also to signal the operator when the splice is completed. As the current flows it lights a small neon lamp coupled to the circuit inductively; when the current stops the light goes out. The operator then knows that the splice is finished and he releases the button. Holding the button down after the lamp goes out produces no further effect on the splice. The splice reaches ultimate strength in less time than it takes to remove it from the jaws, the total splicing time from the instant the button is pushed to removal from the splicer being about one second.

The component parts of a prototype model, designed to be installed on a Bell & Howell professional splicer, are illustrated in Fig. 4. The power supply is designated A, the oscillator box B, and the special lower lefthand splicer plate C. The pushbutton F to energize the circuit may be seen on the oscillator box, as may the neon indicator lamp G.

The four plates, also designed for the Bell & Howell splicer, are illustrated in Fig. 5. The special insulating lower left plate, fabricated from Supramica 555, together with its embedded electrode B is shown at A. The lefthand upper plate, designated C, is a standard Bell & Howell plate with a bevel ground along the edge at D. The righthand upper plate

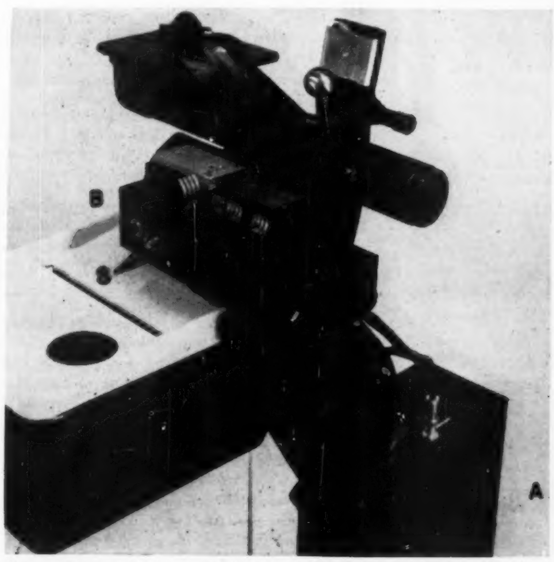

Fig. 6. General view of splicer modified for dielectric heating: A, power supply; B, oscillator; S, contact springs.

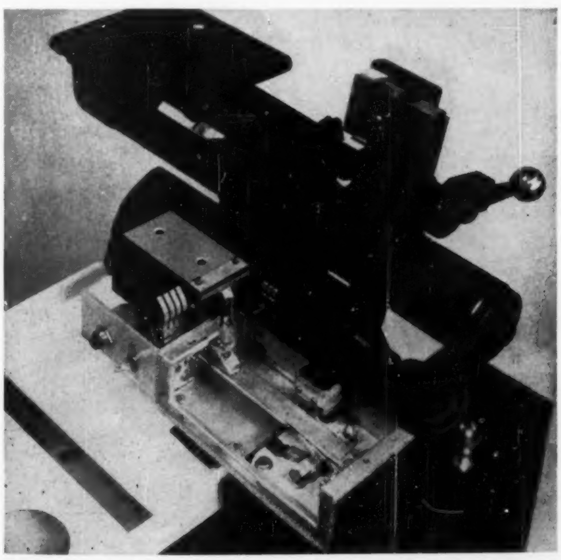

Fig. 7. General view of splicer showing interior of oscillator.

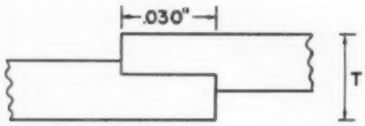

Fig. 8. Dimensions of dielectric splice: T, thickness of 5.6 to 8 mils for 0.004-in. Cronar; T, thickness of 6.9 to 11 mils for 0.0055-in. cellulose triacetate.

Table I. Properties of Splices

	Cronar to Cronar	Triacetate to triacetate	
	Dielectric	Dielectric	Solvent
Overlap (in.)	0.030	0.030	0.072
Base thickness (in.)	0.004	0.0055	0.0055
Splice thickness (in.)	0.0056 to 0.008	0.0069 to 0.011	0.009 min
Tensile, lb to break			
Splice	63	26	70
Base	80	75	75
Peel strength (lb)	10	5.5	4.5

E is a standard plate also, with channels ground and filled with insulating cement at F and G to concentrate the field sharply between the two electrode areas. The lower righthand plate H is also a standard Bell & Howell plate with a bevel ground along edge J.

Figure 6 is a general view of these components installed on a Bell & Howell professional splicer. The power supply is mounted on the rear of the pedestal at A, and the oscillator box with control button and indicator light is positioned just below the splicer jaws at B. The four special plates are also shown in their proper mountings. Springs S provide positive short path groundings of the upper jaws when they are closed, necessary for proper operation of the oscillator. Not visible here, but an important circuit feature, is a safety switch which prevents operation of the circuit unless blades are in the closed splicing position.

Figure 7 shows the interior of the oscillator. Its apparent simplicity is somewhat deceptive in that satisfactory operation requires very careful attention to geometrical details of the elements.

Dimensions of a typical splice made on the prototype equipment are shown in Fig. 8. An overlap of 30 mils has been found to be entirely adequate, surpassing in tensile and peel strength the very best solvent splices in triacetate film. This small overlap has important implications for wide-screen frames where frame separation is held to an absolute minimum. The low overall thickness, attributable to compression during melting, tends to make the new technique especially attractive for splicing negatives.

Strength of Splices

Splice properties are summarized in Table I. The strength of splices prepared by the dielectric method is essentially that of the unspliced film. Their strength is substantially independent of temperature and humidity over the entire range of commonly encountered conditions. They are entirely unaffected by moisture, since no adhesive or solvent is involved. Several hundred of these splices in both Cronar and cellulose triacetate films have been put through black-and-white and color processing machines without a single splice failure.

The peel strength of the dielectric splices is exceedingly high, and a dielectric splice only 30 mils wide is more peel-resistant than a 72-mil solvent splice.

Splices made on the prototype dielectric unit have shown truly remarkable projection performance. For example, a roll containing 80 splices in Cronar polyester based film was projected 1000 times at one hour intervals without a single splice failure. In another test, a cellulose triacetate roll containing 100 splices was projected 500 times in an Excelite 135 high-intensity projector at one-hour intervals through successive working days without failure of a single splice. Throughout these tests the splices remained steady on the screen, and repeated inspections disclosed no sign of deterioration.

The splices described here have been only homogeneous ones, where either base is joined to itself. Either type can be spliced on the same equipment without intermediate adjustments. A satisfactory set of conditions for making mixed splices between Cronar and triacetate films at the quality level attainable for homogeneous splices has not yet been demonstrated, but this goal is being actively pursued.

The splicing unit and technique described in this paper represent the first attempt at adapting the method to one particular make and model of commercial splicer. Some technical problems remain. One of the most important is "bleed-out" of fused film around the ends of the splice. The amount of this bleed-out varies with plate pressure. Efforts are being made to establish conditions for avoiding it. The opinion generally held is that this can be accomplished without great difficulty by means of suitable mechanical adjustments and the control of electrical factors.

It is obvious that further work is needed to develop a unit engineered from a production point of view. Additional adaptation to other makes of commercial splicers and perhaps entirely new splicers designed around the dielectric technique will be needed to take full advantage of the speed, ease of operation and high level of splice quality to be obtained. Basic data on operating conditions and essential features of construction have been obtained from the prototype unit. Pertinent data will be made available by Du Pont to equipment manufacturers who may wish to develop commercial splicers based on the general principle of dielectric heating.

The new splice, with its small overlap, reliability, permanence and strength, is expected to add impetus to possible plans for the early commercialization of devices designed to exploit these characteristics.

Acknowledgments

The developments reported in this paper were made possible through the combined efforts of many Du Pont research workers. In addition to the work in the laboratories of the Research Division, Photo Products Dept., Parlin, N.J., contributions have been made by the Mechanical Development Laboratory of the Engineering Dept., Wilmington, Del.

The important contributions of Francis H. Shepard, Jr., of Summit, N.J., electronics consultant to the Du Pont Company are also acknowledged.

Discussion

George Lewin (Army Pictorial Center): Have you tested this splicer on magnetic film?

Mr. Holm: Yes, and the problem is no different from splicing photographic film, provided you get the oxide off the film. We have also made splices in magnetic film containing a signal with the idea of seeing what the splice would do to the magnetic signal on the film. We found that on a 30-mil splice you get a dropout of about 40 mils width so that the electric field is concentrated quite sharply. This was not audible on a Moviola. We had to actually put the film in measuring equipment; this was done for us by Paramount.

Mr. Lewin: Wouldn't there be a change in electrical capacity due to the magnetic coating, and does that require a readjustment?

Mr. Holm: No, the coating isn't involved; its scraped off, so that all that's involved is the base.

Mr. Lewin: From the explanation that you gave, it seems that the duration of the application of rf power depends on the capacity between the plates, and that this would be affected by the rest of the magnetic coating.

Mr. Holm: The coating is removed from the area between the films where heating takes place. The oxide coating on the upper film is in contact with the electrode, and so stays cool, and it does not seem to change the capacitance

significantly. If you do not get the oxide off the lower film, it burns; I can tell you that.

Albert Abramson (CBS Television, Sun Valley, Calif.): Have you tried butt-splicing by this method?

Mr. Holm: We have not tried butt-splicing because we just haven't had a chance to get to it. We have felt that perhaps a good way to try butt-splicing would be to start with a very narrow overlap and approach it from there. We hope to have more information on that later.

Leonard A. Herzig (Prestoseal Mfg. Corp.): Would a butt-weld on a dielectric type of heating cause arcing and possibly the ruin of the electrodes?

Mr. Holm: I think that would depend on the voltage across the splice. In making splices with the machines that we have now, even with a lapped splice, the tendency to arc has shown itself if the voltage is too high. However, we have made 16mm splices by putting 16mm film on the 35mm electrodes, and with proper voltage adjustment there is no arcing across the uncovered parts of the electrodes.

As far as ruining the electrodes goes, the electrodes would not be ruined by arcing. For a moment you have a little arc welder, it's true, and it leaves a little point on one electrode and a little pit on the other. The pit does no damage; a little pocket stone will take the point off, which can be done in a few seconds, and you're right back in business again. We have done this many times.

A High-Speed Velvet Cleaner for Color Negative

By JOHN W. HARPER

The cleaner described in this paper consists of four velvet-covered wheels mounted in opposed positions between which the negative passes. The first pair of wheels is driven at 1400 rpm in a direction opposite to that in which the negative travels. The second pair moves in the same direction as the film, and is not powered. The wheels are enclosed in a chamber that has a vacuum cleaner attached. This cleaning method virtually eliminates subsequent drum cleaning after the initial cleaning.

As THOSE of us in the industry are well aware, dirt is a costly and time-consuming enemy in the laboratory. Also, the drum-cleaning of negative is a slow process which often results in a bottle-neck in the even flow of film in a processing laboratory. The cleaner described here was developed to cope with the dirt problem and at the same time eliminate as far as possible the time-consuming drum-cleaning.

In the first experiment an atomizing device was used to spray tri-chloroethylene on the color negative before passing through a vacuum box assembly. It failed to give satisfactory results because the cooling effect of the solution caused moisture condensation on the negative. The vacuum box assembly contained four velvet-covered wheels placed in opposed positions that moved in the same direction as the negative. Getting a proper coating of the solution on the negative was a greater problem than had been expected. If the velvets got too wet and soggy, the desired cleaning effect was not accomplished.

Later experimenting showed that if the first two opposing velvet-covered wheels were driven dry in a reverse direction to that of the negative, a better cleaning resulted. The speed with which the first two velvet-covered wheels could travel without damage to the negative was finally set at 1400 rpm after considerable experimenting.

This cleaner incorporates a composition flange with a Bell & Howell keeper and a Hollywood rewind friction clutch on the left part of this assembly where the negative to be cleaned is placed (Fig. 1). A 1/20-hp motor is used to drive the first two opposing velvet-covered wheels. The Lucite plastic vacuum box houses the velvet-covered wheels (Fig. 2). A 1/3-hp torque motor designed to take up 3,000 ft of negative, which will run up to 1200 rpm without a load, supplies the power for the rewind. To counterbalance the speed of the rewinding a centrifugal brake which was taken from a processing machine is used. A hinged composition flange is brought into position parallel to the power rewind flange after the negative is attached to the spool to keep the negative from falling off the flange and insure a tight rewind.

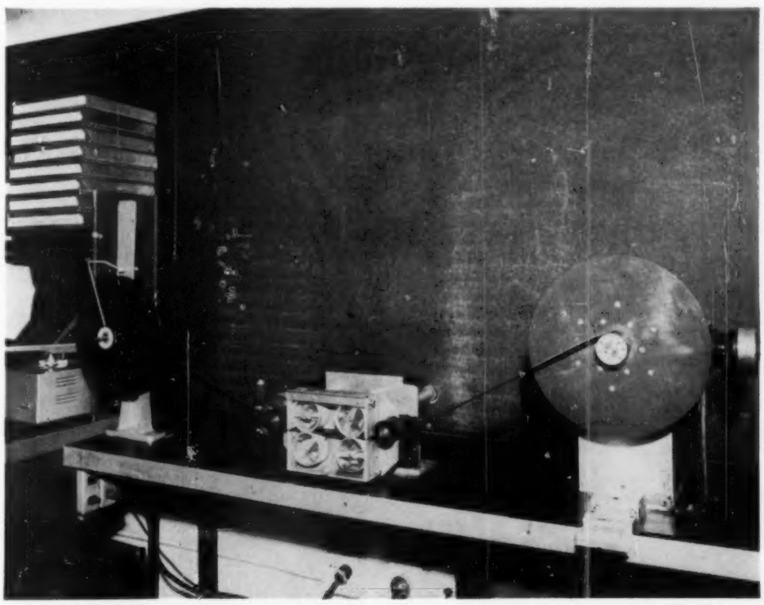

Fig. 1. Full view of high-speed velvet cleaner for color negative, shown mounted on cutting table with power rewind on the right.

Presented on October 9, 1956, at the Society's Convention at Los Angeles by John W. Harper, Pathe Laboratories, Inc., 6823 Santa Monica Blvd., Hollywood 38.
(This paper was received on September 14, 1956.)

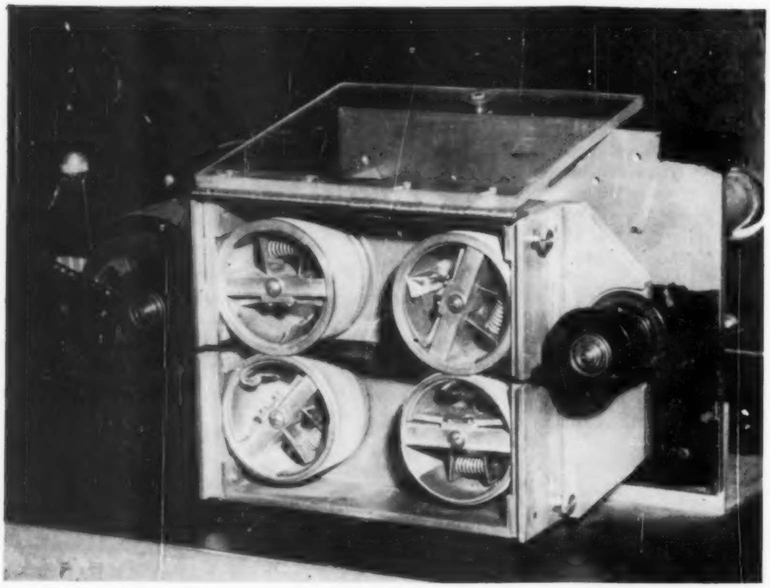

Fig. 2. Close-up view of vacuum box and velvet-covered wheels of high-speed cleaner.

In the initial experimenting an antistatic device was used, but without appreciable success. Initially, too, when it was decided to try reversing the direction of the velvet-covered wheels, a torque converter motor was used, but later found to be unnecessary.

The vacuum box, which is the heart of the cleaning process, is so designed as to allow a maximum amount of suction in the removal of dirt. The dimensions are roughly $6 \times 8 \times 2$ in.

The aperture where the negative enters the box is simply a velvet-covered slot which permits the negative to pass without materially affecting the effectiveness of the vacuum. The outgoing aperture is similarly constructed.

The first pair of velvet-covered wheels traveling counterclockwise flick off the dust and dirt from the negative. The dirt thus removed is sucked to the vacuum aperture. This vacuum aperture is centrally located in the vacuum box for greatest efficiency.

Essentially the second pair of velvet-covered wheels serves as a stabilizer in the vacuum box since the cleaning of the negative has, for all intents and purposes, taken place before the negative reaches the wheels.

An operator can, by using his hand, place additional drag on the flange attached to the power rewind motor, slowing the process or even stopping its motion. To some degree, greater efficiency can be attained by slowing down the process, but ultimately this would defeat the purpose of the cleaner which is basically to save time.

Conclusions

The results from the use of this high-speed cleaner have been most gratifying. Over a period of six months we have reduced our reprints for dirt by at least 50%.

All color negative, after initial drum cleaning, is cleaned through this device before printing and subsequently thereafter before reprinting. The velvets on the wheels are changed three times each week, but this will vary depending on the amount of negative which is subjected to this cleaning.

It takes approximately five minutes to rewind 1,000 ft of negative which is quite a reduction in time as compared to drum-cleaning. The vacuum motor is placed in a room adjoining the location of the cleaner connected by a pipe to the vacuum box which makes for a more quiet operation.

The velvet-covered wheels have a spring-loaded mechanism incorporated in them which allows for easy replacement of velvets. To date not one case of damage to negative resulting from the use of this cleaner has been reported. There are three of these cleaners in operation.

Further experiments are under way to improve this cleaner, especially with a wet velvet application.

Discussion

Lewis H. Humphrey (Moody Inst. of Science): Regarding the transport mechanism, you said the torque converter was no longer needed. Is the torque motor on the takeup the only means of transferring the film through the cleaner?

Mr. Harper: The torque motor on the rewind is the power mechanism for transporting the negative through the blower. When I spoke of a torque converter motor I was referring to the torque converter motor that was used on the motor that drives the first two velvet covered wheels.

Mr. Humphrey: Is the brake on the rewind the only means of changing the speed through the cleaner?

Mr. Harper: Yes.

Mr. Humphrey: How often do you clean a negative this way?

Mr. Harper: We clean a negative after every printing, in the case of dailies or releases or whatever the case may be.

Mr. Humphrey: Have you tried this on 16mm yet?

Mr. Harper: No, we have not.

An Automatic Rewinding and Cleaning Machine for Motion-Picture Films

By A. L. FORD, JR.

This paper describes an automatic machine in which motion-picture film rolls are rewound and cleaned in one operation at 360 ft/min. A new type of combination air and vacuum sqeegee permits cleaning of 3000-ft rolls at this speed. Use of the machine in production permits successive printing of negatives without other periodic wet-cleaning techniques.

In motion-picture printing machines and certain other film handling machines, it is highly essential that the film being handled be completely free of dust, lint and other foreign material. In printing motion-picture film, for instance, even small accumulations of dust on the negative film produce a print of low quality. The removal of such foreign matter from the negative is essential especially in commercial processing laboratories where quality is of prime importance. Present printing procedure, except with continuous printers, is to rewind the negative after each successive printing and to send the negative periodically to a cleaning room for wet process cleaning. The machine, described here, was designed and built by Unicorn Engineering Corp., to rewind and clean 3000-ft rolls of 35mm film at 360 ft/min.

The operation of this machine is quite similar to that of a printing machine. The film roll is placed on a feed hub located in the upper portion of the machine, threaded through a drive unit, a cleaning unit and a control unit, then rewound on a take-up hub in the lower section of the machine (Fig. 1). This operation is accomplished simply by pushing the start button located on the upper left side of the cabinet. The machine is automatic in that once started it does not require the attendance of the operator. It will automatically shut off when the film roll is completely rewound.

The Basic Structure

The machine is comprised of three sections. The primary section is an aluminum cabinet casting consisting of three adjacent panels in vertical alignment, surrounded by four walls (Fig. 1). A Plexiglas door is hinged on the left side wall to complete the cabinet enclosure. The door is equipped with a magnetic latch and finger access holes to the operating switches. All the equipment necessary to guide the film from the feed hub to the take-up hub is located inside this cast enclosure, while all wiring, plumbing, drive and control mechanisms are located on the back.

The secondary sections are the base assembly and the dust enclosure. The base section consists of two identical aluminum leg castings welded together and mounted on stem-type ball bearing casters. A $\frac{3}{8}$-in. plate is bolted across the top of these castings to provide a mounting surface for the cabinet casting and auxiliary equipment as shown in Fig. 2. By using twin leg sections, the casting operation is kept simple and the pattern cost reduced.

The dust enclosure is comprised of two sides, a top and a back welded together to form a rigid, yet lightweight, enclosure for the equipment mounted on the back of the cabinet. This enclosure is notched along the sides to slip over lock pins in the cabinet casting. Holes are provided at the bottom for bolting the enclosure to the base plate. Handles are located on the back for ease in handling.

Mechanical Details

Figure 1 shows a partially rewound roll of film threaded through the machine. The film path is positioned from three separate panel sections of the cabinet casting. The film feed units are mounted on the top panel, the drive and cleaning units on the stepped center panel and the take-up units on the lower panel.

The film feed section contains a 19-in. diameter, satin-finished aluminum flange screwed to the cabinet casting. Passing through the center of this flange is the feed spindle assembly, consisting of a self-locking spool hub on the front end, and a spring-loaded leather clutch at the rear. A braking action is applied to the film roll by this clutch. This action is

Fig. 1. Front and side views of machine.

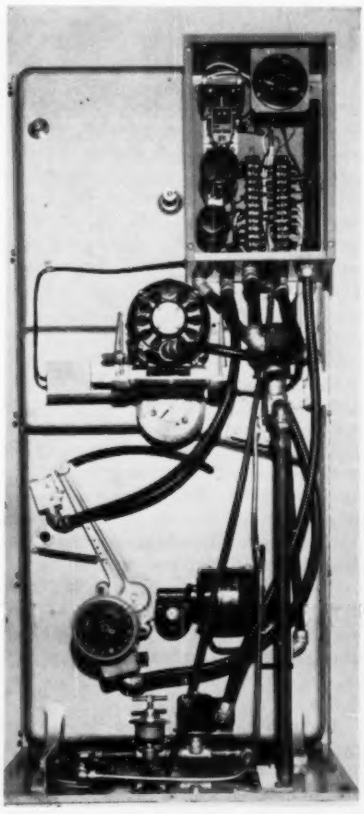

Fig. 2. Back view, dust cover removed.

Presented on October 11, 1956, at the Society's Convention at Los Angeles by A. L. Ford, Jr., Unicorn Engineering Corp., 1040 N. McCadden Pl., Hollywood 38.
(This paper was received on October 19, 1956.)

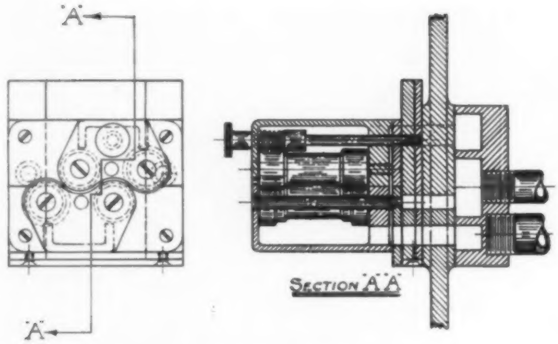

Fig. 3. Two section views of the air cleaner.

regulated by positioning a lock nut at the rear of the spindle to increase or decrease the spring load. A two-position keeper arm is placed in the upper right-hand corner to prevent loosely wound film rolls from spilling off the feed hub.

The film is guided from the feed panel to the drive unit by two flanged, ball-bearing-mounted rollers, similar to printing machine guide rollers. The center section of the rollers is relieved, so that the film is supported on its outer edges, from the inner perforation edge to the outer edge on each side. The picture and track areas are thus protected from abrasion due to contact with the rollers.

The Drive Unit

The drive unit consists of a sprocket mounted on a shaft journaled through the cabinet casting and driven by an electric motor. The sprocket is a standard 32-tooth, 35mm drive sprocket with a relieved center section similar to the guide rollers. The sprocket is pinned to a $\frac{1}{2}$-in. shaft which rotates on ball bearings in the casting. This shaft is long enough to mount a 40-tooth timing belt pulley on the back side of the casting. This pulley is connected to an 18-tooth pulley on the motor shaft by a $\frac{3}{8}$-in. pitch, $\frac{1}{2}$-in. wide timing belt. A $\frac{1}{8}$-hp, 1600-rpm., capacitor-type motor is used to maintain a film speed of 360 ft/min. The motor circuit contains a timer and reduced voltage start to allow a gradual build up to top speed. The motor is mounted on a bracket attached to the cabinet casting. This bracket also acts as a mounting surface for a solenoid-operated brake. This brake consists of an arm with a felt strip cemented to a concave surface of slightly larger radius than the brake drum. It is pivoted on a bearing pin and driven by a rod connected to the solenoid. The brake drum consists of an aluminum disk pinned to the motor shaft.

The film is held firmly on the sprocket by a pair of keeper rollers mounted just above the driveshaft (Fig. 1). These rollers are quite similar to the guide rollers, the principal difference being an extra pair of grooves to allow the rollers to fit over the sprocket teeth. The rollers are mounted on a slide plate which travels vertically in a track plate. The track plate is equipped with a locking arrangement to hold the rollers open, for threading, or closed, in their operating position. An adjusting screw is located in the slide plate to allow for setting the proper gap between the rollers and the sprocket. This screw also prevents the operator from slamming the rollers into the sprocket, as the screw acts as a positive stop.

The Cleaning Unit

The removal of dust, lint and other foreign matter is the purpose of the cleaning unit located immediately after the drive sprocket. Motion-picture film, and especially the original negative film, represents a substantial investment. Extreme care must, therefore be exercised in removing accumulated material from the film so as to avoid scratching, marring or otherwise impairing its quality. This cleaning action is accomplished by means of a new type of combination air and vacuum squeegee.

The squeegee cleaning unit is comprised of two identical casings, each containing two rollers and an air tube mounted on an inner ledge of the casing (Fig. 3). The casing contains an outer chamber which encloses the rollers and air tube, and an inner chamber which acts as a vacuum chamber. The roller enclosure is positioned off center so that when a pair of casings are mated face to face, the air tube of one has a roller of the other directly opposite. This positioning of the rollers eliminates the necessity of a balanced air supply, as the rollers act as supports for the film against the air jets. These rollers are also positioned so the film travels in an S-shaped path, thus maintaining lateral rigidity and rolling contact throughout the unit. More efficient cleaning is obtained by having the air jets strike a convex surface, and by having the inertia, centrifugal and flexure forces of the film act on the foreign matter as the film follows this S path.

Compressed air is blown through a series of small holes in the air tubes directly onto the film. This air and the particles blasted from the film by the jets are then removed by a vacuum line. The vacuum line is set to evacuate more air than is supplied by the air tubes so that additional cleaning is obtained by the air rushing over the film surfaces into the evacuated chambers. This is particularly true at the film outlet end of the squeegee as the relative velocity of air passing over the film surfaces is equal to the sum of the air velocity and the film velocity. Both sides of the film are cleaned at once by the use of the two identical sections. One of these sections is mounted on the slide plate so that it may be opened for threading, and for inspection. The operation is similar to that of the holddown rollers. One roller in each chamber is flanged so that the film is actually guided in and out of the unit.

The air and vacuum arrangement of the squeegee is derived by the use of a manifold on the back side of the cabinet casting (Fig. 3). This manifold consists of two concentric rings. The inner ring supplies air to the air tubes, while the outer ring acts as a collector chamber for the vacuum line. Air under a pressure of 6 psi is brought through a solenoid-operated valve and a filter before entering the inner distributor ring of the manifold. Air is evacuated from the outer ring through a solenoid-operated valve to the vacuum source. The vacuum in the line is 8 in. Hg.

The Take-up Unit

Figure 1 shows the film leaving the cleaning unit, passing over a guide roller and entering the take-up section of the machine. The take-up section is similar to the feed section in that a large flange is screwed to the casting and a self-locking spool hub is located in the center; however, this spool hub is mounted directly on the take-up motor shaft. Before the film is taken up on the spool it passes over a control roller which governs the power of the take-up motor and regulates the tension on the film. This controlled take-up provides a tight wound roll, thus eliminating the necessity of a keeper arm on the take-up panel.

The mechanics of the take-up control are quite simple. A roller, similar to the guide rollers, but provided with larger flanges, is mounted on a spindle passing through a slot in the casting. The spindle is screwed into an arm which is in turn journaled to the cabinet casting. A pair of spur gears with a 4:1 gear ratio is used to control a variable transformer mounted on the back of the cabinet casting. The larger gear is centered on the arm at the pivot point; the smaller is attached to the transformer shaft. The slot in the cabinet casting permits the arm to travel through an arc of 60°, hence 240° rotation of the transformer is utilized in controlling the

power of the take-up motor. A spring is attached to the arm to maintain proper film tension for a tight-wound roll. The take-up motor is a $\frac{1}{20}$ hp, single-phase, capacitor-type motor with a built-in gear reduction producing 500 rpm at the output shaft.

The Electrical System

A switchbox containing a start and stop pushbutton switch, an Eastman Kodak Company Brownie darkroom lamp and a toggle switch for operating the lamp, is mounted on the left wall of the cabinet as shown in Fig. 1. Directly below the switchbox is a spring-loaded plunger which is operated by opening and closing the cabinet door. A microswitch connected to the start and stop circuit is operated by the plunger to prevent operating the machine with the door open.

Another microswitch in the start and stop circuit shuts the machine off when the film has been completely rewound or if a splice separates. This switch, located at the end of the control roller slot, is operated by the control take-up arm (Fig. 2).

Housing for other electrical equipment is provided by a junction box located on the back side of the cabinet casting as shown in Fig. 2. A timer and cushion start relay for the drive motor are located in the upper portion of the box. The drive and take-up motor capacitors, terminal strips and a resistor are in the lower portion.

The drive and take-up motors as well as the air supply and vacuum lines are placed in operation by depressing the start button. These same units are placed in a nonoperating condition by depressing the stop button or by action of any one of the safety microswitches.

Conclusion

The automatic rewind and cleaning machine described in this paper has been in operation at General Film Laboratories Corp., Hollywood, California, for more than three months. Successive prints of good quality have been made from 3000-ft rolls of negative without the use of wet cleaning techniques. The use of this machine has saved considerably in production time.

High-Speed Explosive Argon-Flash Photography System

By ROBERT G. S. SEWELL,
LAWRENCE N. COSNER,
HENRY W. WEDAA
and ROLLAND GALLUP

This report describes a method of taking successive photographs of high-speed transient events by means of an argon-explosive system. The system comprises an explosive-train assembly, a Fresnel lens, and a number of cameras. The photographic results of a series of plate-perforation tests using 20-mm rounds are presented.

THE USE OF explosively produced shock waves in argon as a means of obtaining brilliant illumination for photographing transient events has been known for a number of years.[1-7] Many investigators, especially in the field of ballistics, have taken advantage of this phenomenon to produce high-quality photographs in the submicrosecond exposure range. The application of this phenomenon, however, appears to have been limited to single-exposure photographs with still cameras or to multiple exposures with relatively expensive high-speed cameras and auxiliary equipment. The use of multiple sparks for obtaining a series of submicrosecond photographs was developed by Cranz-Schardin in 1928–29.[5,6] The system described here replaces the multiple sparks of the Cranz-Schardin system thereby simplifying the apparatus, reducing the cost, and providing a greater level of illumination.

Presented on October 10, 1956 at the Society's Convention at Los Angeles by Robert G. S. Sewell (who read the paper), Lawrence N. Cosner, Henry W. Wedaa and Rolland Gallup, Warhead Research Branch, Propellants and Explosives Dept., U.S. Naval Ordnance Test Station, China Lake, Calif.
(This paper was received on October 15, 1956.)

Described here is the means by which a series of photographs can be taken of high-speed, transient events: a simple, inexpensive explosive-argon system, with appropriate optics.

Overall Operation

The system combines the submicrosecond exposure advantages of argon flash with the advantages of still cameras to achieve an extremely high-framing-rate motion-picture system at a very low cost. It consists of (1) a specially designed explosive-train system to give an appropriate time delay between flashes; (2) a plastic Fresnel condensing lens; and (3) several still cameras. The arrangement of the system is shown schematically in Fig. 1, and pictorially in Fig. 2.

A projectile is fired into the impact plates which function as a device for triggering the electric detonator. When the projectile penetrates the first plate and comes in contact with the second plate, the circuit is completed and an impulse is sent to the detonator. The detonator initiates a short length of primacord which has three explosive branches that are terminated in a cavity filled with argon. As the primacord successively initiates the explosive branches, the light flash from each branch, passing through a hole in the steel barrier, is focused by the Fresnel lens into the appropriate camera. The impact plates and the trajectory of the projectile must be placed near enough to the Fresnel lens so that they are in the light beams from each explosive branch. An image of the projectile and plates is focused on the film plane of the appropriate camera.

The cameras used in this experiment were 4 × 5 in. Graphic View with 15-in. telephoto lenses. However, any camera with a shutter capable of taking time exposures may be used. If open-shutter synchronization is used, the system must either be operated at night or in a light-excluding enclosure. It was operated at night for the test firings described in this report. Although only three cameras were used in these tests, the system is not restricted to any given number of cameras.

Analysis of Component Systems

Explosive System

The flash-producing explosive train system is shown in Fig. 3. It is made of a block of wood 2 in. square by 16 in. long. A groove $\frac{1}{8}$ in. wide and $\frac{1}{8}$ in. deep is cut in the center of one face to the length of the block to accommodate the flow of argon. A $\frac{3}{16}$ in. wide by $\frac{3}{8}$ in. deep groove is cut to the length of the charge in the center of the opposite face to accommodate the primacord.

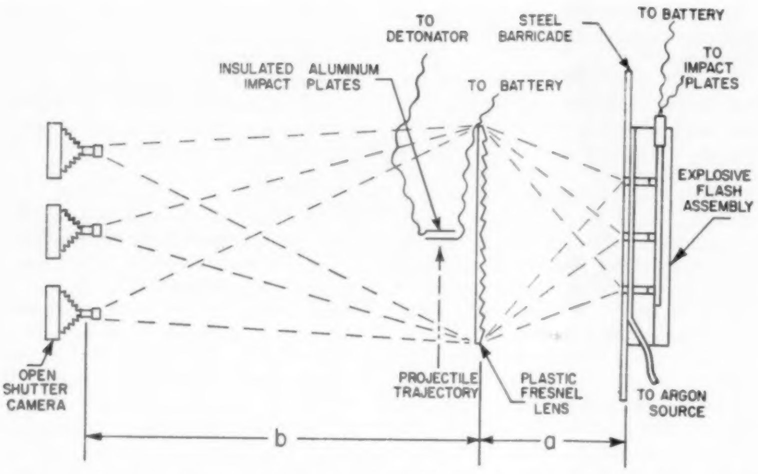

Fig. 1. Schematic diagram of the high-framing-rate, argon-flash, field-photography system.

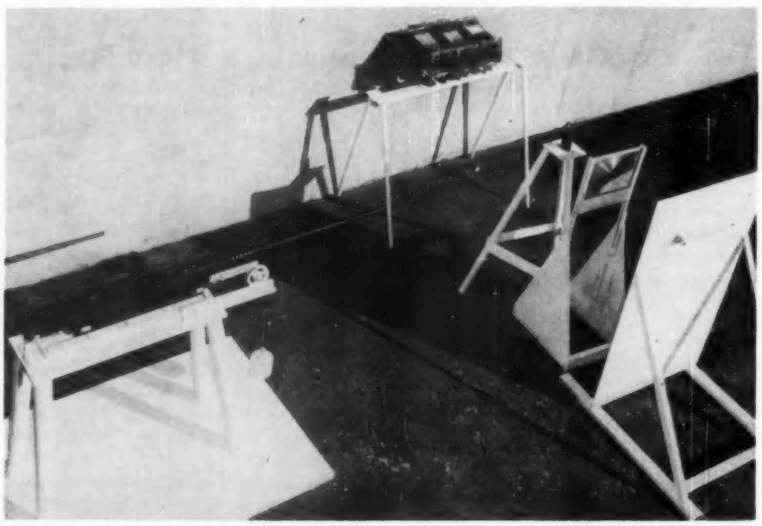

Fig. 2. Top view of the high-framing-rate, argon-flash, field-photography system.

From one end of the block a hole to hold the hose from the argon source is drilled diagonally to the argon channel; the other end is drilled for holding an M-36 special electric detonator tightly against the primacord. Equally spaced holes are drilled from the primacord groove to the bottom of the argon groove to accommodate the tetryl pellet and the flash detonator. The flash detonator is inserted between the primacord and the tetryl pellet to facilitate detonation of the tetryl, since most high explosives are difficult to detonate by a detonation wave which approaches at 90°.

The time required between flashes determines the spacing between the explosive branches. In the system employed in these tests the explosive train was designed to produce three light flashes at 12-μsec intervals. Taking the detonation velocity of primacord as $\frac{1}{4}$ in./μsec, a 3-in. distance between tetryl trains would give the 12-μsec intervals. Since the holder is made of wood it can be easily reproduced or it can be modified to accommodate several flash-producing explosive trains.

A piece of transparent cellophane tape is placed over the argon channel to act as a retainer for the argon as it flows past the ends of the explosive branches. The channel, open at its end, permits the argon to flush through it continuously, both before and during the firing period. The steel barricade on which the charge holder is bolted may be drilled for any number of light sources. Its primary function is to protect the system from blast and to prevent extraneous light from the detonating explosive from reaching the Fresnel lens.

The system gives an effective framing rate of 83,333 frames/sec, but almost any framing rate can be obtained. Theoretically the framing rate may be infinite. In practice, however, the highest framing rate would probably be under 500,000 frames/sec.

If a framing rate of a million frames/-sec were desired, the primacord timing delay system shown in Fig. 3 would not be of much value. However, if a right-triangular sheet of explosive with one leg of the triangle in contact with the tetryl trains were used, and initiated at the apex farthest from them, the detonation front would be essentially a plane wave approaching them at an oblique angle. The framing rate, then, is a function (1) of the detonation velocity of the explosive, and (2) of the angle between the tetryl pellets and the approaching plane wave.

Figure 4 is a high-speed, rotating-mirror, streak-camera photograph which shows the duration and time separation of the successive flashes. The duration of an individual flash explosive in the argon, as observed from the streak photograph, is about 0.4 μsec. The calculated value, assuming the shock-wave velocity immediately adjacent to the explosive equal to the detonation velocity of tetryl, would be 0.43 μsec. Some care should be exercised by personnel untrained in the proper handling of explosives to prevent the premature detonation of the tetryl pellets or flash detonators. The primacord is safe to handle.

Photographic System

The optical arrangement of the photographic system can be explained most

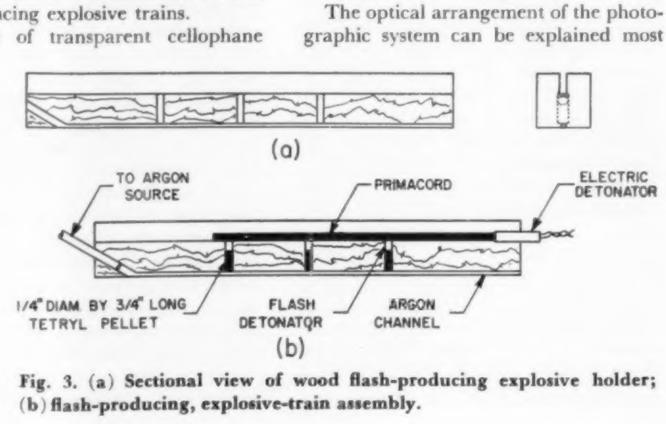

Fig. 3. (a) Sectional view of wood flash-producing explosive holder; (b) flash-producing, explosive-train assembly.

Fig. 4. High-speed, rotating-mirror streak photograph of the argon flashes.

simply with reference to Fig. 1. The chief components of this system are three 4 × 5 in. Graphic View Cameras with 15-in. telephoto lenses and a 12 × 16 in. rectangular plastic Fresnel condenser lens with a 16-in. focal length.

The cameras are placed next to each other, in line, as shown in Fig. 1. In the tests reported the lenses were about 8 in. apart. The time between exposures required for the experiment described in the section on Over-all Operation is 12 μsec, which corresponds to the detonation rate of 3 in. of primacord. The arrangement described imposes a set of conditions which control the distance between the argon-flash light source, the Fresnel lens, and the camera lenses.

The image distance (b of Fig. 1) is the distance between the camera lens and the Fresnel lens. The object distance (a of Fig. 1) is the distance between the argon-flash light source and the Fresnel lens.

The condition imposed is the magnification (M), which is equal to 8/3

$$\frac{8}{3} = M = \frac{b}{a}$$

therefore $$\frac{1}{a} = \frac{8}{3b}$$

and by the lens formula $$\frac{1}{f.l.} = \frac{1}{a} + \frac{1}{b}$$

or $$\frac{1}{16} = \frac{1}{b} + \frac{8}{3b}$$

From this, then, the image distance (b) must be 58$\frac{2}{3}$ in., and the object distance (a) must be 22 in.

The placement of the lens diaphragm axially with respect to the focal point of the Fresnel lens is not too critical. The diaphragm opening, however, must be smaller than the light beam so as to obtain a good silhouette type photograph. It must be emphasized that to obtain the best shock-wave pattern, the diaphragm opening for the case discussed (1) should be between $f/16$ and $f/32$, (2) should be near the focal point of the Fresnel lens, and (3) should concentrically cut off part of the light beam from the Fresnel lens, thus enhancing the silhouette effect.

To obtain the best possible combination of film type, developer, development time and lens diaphragm opening, several tests were conducted. The different types of black-and-white film tested were infrared, Linagraph Shellburst Panchromatic, Triple S Ortho and Royal Panchromatic. Infrared film was found to be superior, and as such it was used to take the photographs shown in the results. To obtain sharp contrast within the shock-wave patterns, the films were developed in undiluted Eastman Developer D-11 for four minutes at 68F.

Color transparencies of good quality were obtained with Type B Ektachrome film. Necessary film-speed increase was effected by a 50% over-development in the first developer. The over-development permitted stopping the lens down to $f/22$ for good shock-wave patterns and also increased the contrast needed for good shock-wave definition.

All the photographs shown were taken at night. Some attention was given, incidentally, to finding a means of getting such pictures by daylight. The infrared and Linagraph Shellburst Panchromatic were tested with and without XRX-20 and XRX-30 filters. Sufficient image density was obtained on infrared film through the XRX-30 filter to indicate that a filter of less density (XRX-40 or XRX-50), might make possible the daytime use of this system, provided the camera shutters were closed after not more than a few seconds exposure to average daylight conditions.

Firing System

The electrical firing system is partially shown in Fig. 1. A 500-v power supply was connected in series with aluminum impact plates and the electric detonator. The impact plates were made of two

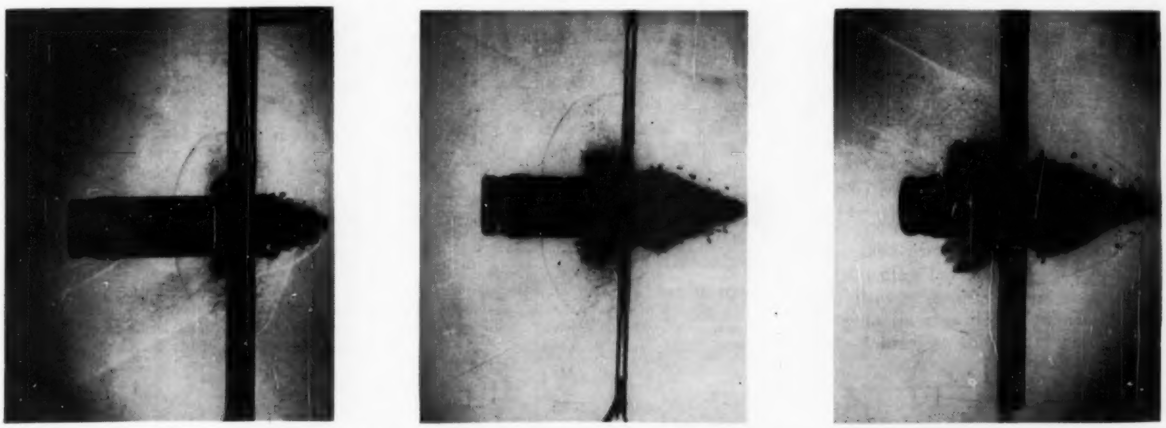

Fig. 5. A series of three pictures taken with the high-framing-rate, argon-flash, field-photography system, showing a 20-mm standard practice round penetrating two $\frac{1}{32}$-in. aluminum plates.

Fig. 6. A series of three pictures taken with the high-framing-rate, argon-flash, field-photography system, showing a 20-mm practice round with a conical nose penetrating two $\frac{1}{32}$-in. aluminum plates.

Fig. 7. A series of three pictures taken with the high-framing-rate, argon-flash, field-photography system, showing a 20-mm practice round with a flat nose penetrating two $\frac{1}{32}$-in. aluminum plates.

aluminum plates $\frac{1}{32}$ in. thick by 2 in. wide by 6 in. high. They were separated at top and bottom by a $\frac{1}{32}$ in. thick by 2 in. wide by $\frac{1}{2}$ in. high Micarta sheet. The Micarta sheets leave most of the plates separated by a $\frac{1}{32}$ in. thick air gap, through which the projectile passes at normal incidence. When the projectile makes contact with both plates, the series circuit is completed and the detonator is initiated by the 500-v power source. In the initial experiments low voltages were used, but the delays in detonator initiation were so erratic that the projectile had passed beyond the impact plates when the detonator fired. The 500-v power supply gives a consistent delay in detonator initiation of 20 to 30 μsec. The delay corresponds to about one inch of projectile penetration as shown in Figs. 5, 6 and 7.

Tests and Results

Tests of the system were made, and the results may be seen in Figs. 5, 6 and 7. The photographs were taken with infrared film. The diaphragm opening was $f/22$. The figures show projectiles traveling at a velocity of about 2700 ft/sec and penetrating two $\frac{1}{32}$ in. aluminum impact plates. The projectiles used were all made from 20-mm practice rounds. Figure 5 shows a standard practice round. Figure 6 shows a practice round machined to the shape of a sharp-nosed cone. Figure 7 shows a practice round with a flat-nose section.

Conclusions

An effective method of obtaining successive photographs of high-speed transient phenomena by means of an explosive-argon system has been developed. Its method of operation is extremely simple, and the cost is slight. By making suitable adjustments in the explosive system, the framing rate can be changed.

Because of its simplicity, the system readily lends itself to use in the field, where special equipment is not available.

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Discussion

Lincoln L. Endelman (Convair, San Diego, Calif.): Under what pressure was the argon gas fed into the trough and did you also try an electronic means of igniting it?

Mr. Sewell: The gas was under just sufficient pressure to cause continuous flow through the system. While a luminous shockwave may be generated by an electronically controlled spark discharge, we did not try such a system. Some of the shortest exposures I have heard of have been obtained by explosive means similar to ours; the shortest which can be readily obtained is approximately 1/300th of a microsecond.

motion-picture standards

Three Proposed American Standards

PH22.108

A proposed American Standard, PH22.-108, Four Magnetic Sound Records on 35mm Film, is published here for a three-month period of trial and comment.

This proposal was initiated by the Society's Sound Committee in October 1955 and was approved by this committee in August 1956 and by the Standards Committee in November 1956. It conforms to U.S. practice and is modeled after an international proposal developed at the June 1955 Stockholm meeting of International Standards Organization Technical Committee 36 on Cinematography.

All comments should be sent to Henry Kogel, SMPTE Staff Engineer, prior to April 15, 1957. If no adverse comments are received, this proposal will then be submitted to ASA Sectional Committee PH22 for further processing as an American Standard.—*H.K.*

PH22.109 and PH22.110

Two Proposed American Standards, PH22.109, Dimensions for 16mm Motion-Picture Film, 1R-2994, and PH-22.110, Dimensions for 16mm Motion-Picture Film, 2R-2994, are published here for a three-month period of trial and comment.

The general decrease in the shrinkage characteristics of films over the last few years required consequent modifications of long established cutting and perforating dimensions of certain films. PH22.93-1953, Dimensions for 35mm Motion-Picture Short-Pitch Negative Film, and PH22.73, Dimensions for 35mm Motion-Picture Film, Perforated 32mm, 2R-2994, are standards reflecting this condition in the area of 35mm films. In those standards the primary change was decreasing dimension B, the pitch of the perforations, and dimension L, the length of 100 perforations. In the 16mm proposals presented here, these same modifications have been made but, in addition, the nominal value of dimension A, the film width, has been decreased one mil. This decrease in dimension A was necessitated by the fact that this low shrink film occasionally tended to stick in the aperture gate when subjected to high humidity conditions. This did not happen to film with the greater shrinkage characteristic since it normally shrank sufficiently to keep its maximum width below 0.630 in. (the projector gate width) regardless of moisture absorption under high humidity conditions.

With the addition of the positive tolerance, dimension A is specified in these proposals as 0.629 in. maximum. To preclude any disposition on the part of equipment manufacturers to decrease the width of the gate an appendix has been added which calls attention to the fact that the gate must continue to accommodate a film width of 0.630 in.

All comments should be sent to Henry Kogel, SMPTE Staff Engineer, prior to April 15, 1957. If no adverse comments are received, these proposals will then be submitted to ASA Sectional Committee PH22 for further processing as American Standards.—*H.K.*

Proposed American Standard

Four Magnetic Sound Records on 35mm Film

PH22.108

1. Scope

1.1 This standard specifies the lateral location and dimensions of the magnetic sound recording heads for recording four magnetic sound records on 35mm motion-picture film.

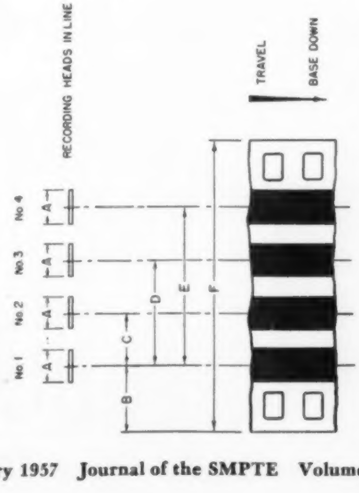
1.2 This standard relates the placement of the magnetic coating on the film to the direction of film travel.

2. Dimensions

2.1 The dimensions shall be as specified in the diagram and table.

3. Magnetic Coating

3.1 With the direction of film travel shown in the diagram, the magnetic coating shall be on the upper face of the film base.



Dimension	Inches	Millimeters
A	0.154 max	3.91 max
	0.150 min	3.81 min
B	0.314 ± 0.002	7.98 ± 0.05
C	0.250 ± 0.002	6.35 ± 0.05
D	0.500 ± 0.002	12.70 ± 0.05
E	0.750 ± 0.002	19.05 ± 0.05
F	1.378 nom	35.00 nom

NOT APPROVED

Proposed American Standard

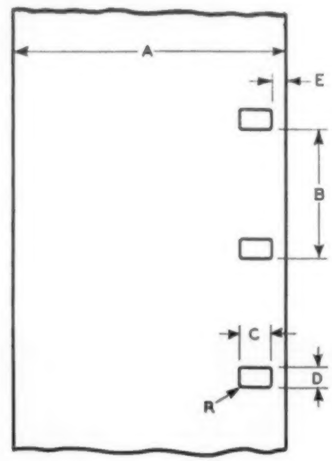
Dimensions for 16mm Motion-Picture Film, 1R-2994

PH22.109

1. Scope

1.1 This standard specifies the cutting and perforating dimensions of 16mm motion-picture film with perforations along one edge.

1.2 These dimensions pertain to a safety film with low-shrinkage characteristics as defined in Appendix 1.



2. Dimensions

2.1 The dimensions shall be as given in the diagram and table.

2.2 These dimensions apply to negative raw stock immediately after cutting and perforating.

2.3 In any group of four consecutive perforations, the maximum deviations from aim pitch shall be held to a value as much smaller than 0.001 in. as can be obtained. This is desirable because of the beneficial effect on steadiness thus realized.

2.4 Dimension L represents the length of any 100 consecutive perforation intervals.

Dimensions	Inches	Millimeters
A	0.628 ± 0.001	15.95 ± 0.03
B	0.2994 ± 0.0005	7.605 ± 0.013
C	0.0720 ± 0.0004	1.829 ± 0.010
D	0.0500 ± 0.0004	1.270 ± 0.010
E	0.0355 ± 0.0020	0.902 ± 0.051
L	29.94 ± 0.03	760.5 ± 0.08
R	0.010	0.25

NOT APPROVED

NOTES

1. The dimensions in the inch system are the fundamental standard. The dimensions in the metric system are practical approximations based on American Standard B48.1-1933, reaffirmed in 1947, providing a conversion factor of 1 inch = 25.4 millimeters.

2. The title of this standard was established by the application of a nomenclature system developed for all film dimension standards: Each title provides an indication of the film width, the perforation pitch (without the decimal point) and the perforation shape (BH, KS, DH or CS) or number of rows of perforations (1R, 2R or 4R), depending on which is the significant factor.

3. This standard differs from American Standard PH22.12-1953, Dimensions for 16mm Film, Perforated One Edge, primarily in the values for dimensions A, B and L which are specified there respectively as 0.629 ± 0.001 in., 0.3000 ± 0.0005 in. and 30.00 ± 0.03 in. (See Appendixes 2 and 4.)

APPENDIX 1

For the purpose of this specification, low-shrink film base is film base which, when coated with emulsion and any other normal coating treatment, perforated, kept in the manufacturer's sealed container for six months, exposed, processed and stored exposed to air having a temperature of 65 F to 75 F, 18 C to 24 C, and a relative humidity of 50% to 60%, for not more than 30 days, and measured under like conditions of temperature and humidity, shall have shrunk not more than 0.2% from its original dimension at the time of perforating.

APPENDIX 2

Experience shows that it is common for film to expand when exposed to high relative humidity. Allowance should be made for this factor in equipment design and in no case should the equipment design fail to accommodate a film width of 16mm, 0.630 in.

APPENDIX 3

To comply with ¶1.2, this film is made on safety base complying with American Standard PH1.25-1956, Safety Photographic Film.

APPENDIX 4

Films which after processing are intended to pass through a continuous contact printer in which the exposure is made over a cylindrical surface do not yield prints of maximum steadiness unless the actual pitch of the film curved to the smaller radius (the "negative") is slightly less than that of the film curved to the larger radius (the "print stock"). Since positive films in general are perforated to a nominal 0.3000 in. pitch and since negative-type films with low-shrinkage characteristics do not shrink enough for optimum pitch relationship with such positive films, the nominal 0.2994 in. pitch was developed for films to be used primarily as negatives for the subsequent production of prints. They also find other specialized uses.

NOT APPROVED

Proposed American Standard

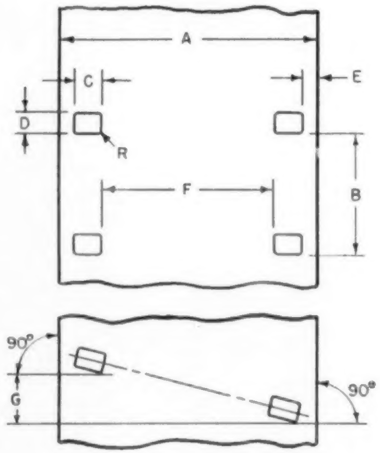
Dimensions for 16mm Motion-Picture Film, 2R-2994

PH22.110

1. Scope

1.1 This standard specifies the cutting and perforating dimensions of 16mm motion-picture film with perforations along two edges.

1.2 These dimensions pertain to a safety film with low-shrinkage characteristics as defined in Appendix 1.



2. Dimensions

2.1 The dimensions shall be as given in the diagram and table.

2.2 These dimensions apply to negative raw stock immediately after cutting and perforating.

2.3 In any group of four consecutive perforations, the maximum deviations from aim pitch shall be held to a value as much smaller than 0.001 in. as can be obtained. This is desirable because of the beneficial effect on steadiness thus realized.

2.4 Dimension L represents the length of any 100 consecutive perforation intervals.

Dimensions	Inches	Millimeters
A	0.628 ± 0.001	15.95 ± 0.03
B	0.2994 ± 0.0005	7.605 ± 0.013
C	0.0720 ± 0.0004	1.829 ± 0.010
D	0.0500 ± 0.0004	1.270 ± 0.010
E	0.0355 ± 0.0020	0.902 ± 0.051
F	0.413 ± 0.001	10.49 ± 0.03
G	0.001 max	0.025 max
L	29.94 ± 0.03	760.5 ± 0.08
R	0.010	0.25

NOT APPROVED

NOTES

1. The dimensions in the inch system are the fundamental standard. The dimensions in the metric system are practical approximations based on American Standard B48.1-1933, reaffirmed in 1947, providing a conversion factor of 1 inch = 25.4 millimeters.

2. The title of this standard was established by the application of a nomenclature system developed for all film dimension standards: Each title provides an indication of the film width, the perforation pitch (without the decimal point) and the perforation shape (BH, KS, DH or CS) or number of rows of perforations (1R, 2R or 4R), depending on which is the significant factor.

3. This standard differs from American Standard PH22.5-1953, Dimensions for 16mm Film, Perforated Two Edges, primarily in the values for dimensions A, B and L which are specified there respectively as 0.629 ± 0.001 in., 0.3000 ± 0.0005 in. and 30.00 ± 0.03 in. (See Appendixes 2 and 4.)

APPENDIX 1

For the purpose of this specification, low-shrink film base is film base which, when coated with emulsion and any other normal coating treatment, perforated, kept in the manufacturer's sealed container for six months, exposed, processed and stored exposed to air having a temperature of 65 F to 75 F, 18 C to 24 C, and a relative humidity of 50% to 60%, for not more than 30 days, and measured under like conditions of temperature and humidity, shall have shrunk not more than 0.2% from its original dimension at the time of perforating.

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Experience shows that it is common for film to expand when exposed to high relative humidity. Allowance should be made for this factor in equipment design and in no case should the equipment design fail to accommodate a film width of 16mm, 0.630 in.

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NOT APPROVED

news and reports

81st Convention Program

As the papers program for the 81st Convention takes shape, it is apparent that a variety of subjects will be covered, with emphasis in some areas not featured at previous Conventions.

Washington conventions have held many attractions for the wives of members, and the 81st will be no exception. In addition to an excellent Ladies' Program, the Monday evening session, called, "Industry Milestones," will be enjoyed by the ladies as much as by their husbands. The feature of this session will be a replica of one of the delightful evenings of the Dryden Film Society of George Eastman House, and will include the showing of a feature film which is one of the great ones of the past.

A feature of the program will be the sessions on the Audio-Visual Uses of Motion Pictures and Television, for which Topic Chairman John Flory is arranging a group of excellent papers. The Tuesday morning session will be held at the Walter Reed Army Medical Center, and will be devoted to descriptions, demonstrations and inspection of the Center's impressive closed-circuit color television system. Prior to the Convention, it is expected that this television installation will be given nationwide magazine and TV network publicity. The new color film processing laboratory at Walter Reed will also be inspected.

One of the missions of the Society is to sponsor the establishment of American and International Standards in motion pictures. To further this mission, an entire session of the program will be devoted to "Standards and Standardization."

A large number of papers on "Laboratory Practices" will require two full sessions, with emphasis on printers and printing techniques.

The Film Projection and Viewing Session will offer papers on projector design, flicker, screen brightness and optics. The problems of the theater exhibitor, and the projectionist and theater maintenance engineer will be discussed in a session on Theater Operation.

Two sessions are planned on Instrumentation and High-Speed Photography. One will be a concurrent session, but the other, a symposium on Missile Photography, will be of general interest and hence will enjoy large and general attendance.

The Television, Cinematography, and Sound Recording and Reproduction sessions will introduce new equipments and techniques in these fields.

TENTATIVE DAILY SCHEDULE

April 29 – May 3 at the Shoreham Hotel, Washington, D.C.

Monday

Morning: Registration
Afternoon: Standards and Standardization
Evening: Industry Milestones

Tuesday

Morning: Walter Reed Army Medical Center—closed-circuit color television.
Afternoon: Audio-Visual Uses of Motion Pictures and Television.
Evening: Television

Wednesday

Morning: Laboratory Practice I
Afternoon: Laboratory Practice II
Evening: Banquet

Thursday

Morning: Instrumentation and High Speed Photography—General Joint Session on Missile Photography
Afternoon: Concurrent Session—Instrumentation and High Speed Photography
Afternoon: Concurrent Session—Projection and Viewing
Evening: Theater Operation

Friday

Morning: Cinematography
Afternoon: Sound Recording and Reproduction

PAPERS

The procedures and the persons through which the program's papers are procured were set forth in full in the December 1956 *Journal* by Papers Committee Chairman Ben Plakun. Prospective papers are preferably channeled through the Regional Chairmen or Topic Chairmen listed in the December *Journal*, p. 658. Author's Forms are due by March 1, 1957, and manuscripts by March 29.

Inquiries about prospective papers and their scheduling are welcome.—*Joseph E. Aiken*, 81st Program Chairman, 116 N. Galveston St., Arlington 3, Va.

International Photographic Exposition 1957

SMPTE is to play an active role in the Second Biennial International Photographic Exposition, an announcement of which appeared in the April 1956 *Journal*, p. 229. Scheduled for March 22–31 at the National Guard Armory in Washington, D.C., this will not only consist of perhaps the largest display of still and motion-picture photographic equipment ever assembled in this country, with more than 250 exhibitors from all over the world, but there will also be a busy program of trade and technical meetings.

The Photographers' Association of America will be conducting a National Industrial Photographic Conference March 25–29, and other organizations taking part, such as the Photographic Society of America, are also planning technical sessions.

SMPTE and the American Standards Association will be represented by displays in adjoining booths, emphasizing their joint work in the field of photographic standards. The show, which will be open to the trade in the afternoons and to the public in the evenings, is expected to draw an attendance of 150,000, and the SMPTE display will therefore try to present a general picture of all the Society's activities and services to the industry. Keith Lewis and members from the Washington Section will be on hand to man the booth and answer questions about the Society. The booth and display materials are being prepared by Society headquarters.

The Exposition falls just a month before the SMPTE Spring Convention which will also be in Washington. Certainly all members in the Washington area, and any others who may be within reach at the end of March, should not miss the opportunity of visiting this tremendous show and checking in to say hello at the SMPTE booth.—*D.C.*

New Members — 1957 Directory

Since publication of the April 1956 *Journal*, Part II, A Directory for Members, supplementary lists were published during 1956. These are now discontinued because 1957 plans call for again publishing A Directory for Members as Part II with the April *Journal*. Members whose addresses on their *Journals* are not as they want them to appear in the 1957 Directory should advise Society headquarters by March 1.

Speaking of new members, or older, wiser ones, perhaps the only generalization that can be made is that they share a common interest in the advancement of motion-picture and television engineering. A member of the SMPTE may live in Iceland or Iran or anywhere on earth. He may be a college professor or student, inventor or executive, and the chances are that sometime or other the member or potential member will write to Headquarters for information about the aims and purposes of the Society or for help on some specific problem.

Recently the Editor received a letter from a would-be member who seemed to be a little confused about the services offered by the Society. "All my life..." the would-be member wrote, "I have wanted to have a letter and autographed photo of a female American Star." The man was not only confused about the extent of the Society's services but he must have been confused on other occasions. The letter was written while he was serving a prison sentence. But he really wanted to join the Society. "I have promised myself," he wrote, "and I will promise you, sir, that I will endeavour to become a member when I am free once more."

Survival of Old Motion Pictures

A priceless record of America's past will be lost forever unless funds can be raised to preserve more than one million feet of motion pictures now in the Copyright Division of the Library of Congress.

The Academy of Motion Picture Arts and Sciences undertook in 1948 the work of transferring to standard film the archives of newsreels and documentary motion pictures printed on paper. The rolls of paper are deteriorating so rapidly that in a few years reclamation will be impossible, but the work has been halted because of lack of funds.

What is the story about these irreplaceable rolls of motion pictures and why is it so important that they be preserved? Much of the story was first told in the pages of the *SMPE Journal* in March 1944. A paper by Carl Louis Gregory, "Resurrection of Early Motion Pictures," told of the discovery made by the Library of Congress that it had "tucked away in its old repositories, a priceless and almost complete collection of all the motion pictures made in the United States from 1896 to 1912. This collection is printed on fragile ribbons of paper and cannot be projected in its present form."

The reason for the existence of these "fragile ribbons of paper" was explained in the same issue by H. L. Wallis of the Library of Congress. Prior to 1912, Mr. Wallis said, the Copyright Act contained no provision for the registration of motion pictures. The early producers, Edison, Biograph, Melies, Lubin and others, developed an ingenious method of procuring copyright protection. Although strips of celluloid film could not be copyrighted, the same pictures if printed on paper could be registered as photographs. So from 1897 until 1912 it was common practice for producers to make two positive paper prints for copyright purposes of each motion picture filmed.

Mr. Gregory, then with the Division of Motion Pictures and Sound Recording of the National Archives, had designed a machine for the reproduction of old and shrunken film. He found that this same machine might be adapted to reproduce the fragile ribbons of paper stored in Library vaults. Later Kemp Niver developed a system called the Renovare Process that was found to be adequate to the demands of reproducing the photographs. The sizes of the paper prints range from 18mm to 58mm.

The importance of preserving these photographic records of our own past — the past of America — such as Theodore Roosevelt leading the charge up San Juan Hill, President McKinley a half-second before he was assassinated, and thousands of other pictures of historic events can hardly be estimated in dollars and cents terms.

The Academy has spent $125,000 to transfer more than 126,000 feet of paper prints to standard film. Film for the project was contributed and the processing was also contributed. A sum estimated at $250,000 is required to complete the work of rescuing the priceless records from destruction, but Congress has consistently

refused to appropriate any sum at all for the preservation of these records. This refusal of funds raises a question. Perhaps a doubtful future makes a regard for the past seem mere sentimentality. But a sense of the past is one of the attributes that distinguishes man from animal. A recently published story in the science-fiction genre tells of a motion-picture camera that could photograph events in the past. For example, the owner of the camera traveled to Rome (in 1956) to record on film the assassination of Julius Caeser as it actually occurred. That and other historic events recorded by the super-scientific camera showed that even eye-witness accounts deviated considerably from the actuality of the event.

This story and others based on the concept of the continuity of time are related to certain human traits such as curiosity (what *really* happened?), a groping toward truth — and/or — knowledge (*what* really happened?) and a deep-rooted sense of being part of the mainstream of history (what really *happened*?).

Unfortunately there is no super-scientific camera that can photograph the past. Once gone, these Library of Congress motion pictures will never again be seen. Within two or three years, according to George Seaton, Academy President, these irreplaceable pictures will have deteriorated beyond any possibility of reclamation.—*R.H.*

Education, Industry News

Grants for promoting the study of science and mathematics are included in the million-dollar fund held by the E. I. du Pont de Nemours & Co., Wilmington, Del., for its aid-to-education program. A total of 122 universities and colleges will share in the benefits. The company is awarding $585,000 to colleges and privately supported universities to advance the teaching of science, mathematics and other liberal arts subjects. In addition to graduate fellowships and aid to undergraduates, the company is, for the first time, awarding grants of $4,000 each to 23 major universities with which to strengthen undergraduate teaching of courses that contribute significantly to scientific and engineering education.

J. F. O'Brien, Manager, Theater and Sound Products Dept., RCA Commercial Electronic Products, has been appointed Manager of RCA's Northeastern Region, an appointment which makes him the principal RCA executive in the Region. His headquarters will be at the RCA offices in Boston.

Willett R. Wilson has been appointed Commercial Engineering Manager of the Photo Lamp Department of the Westinghouse Lamp Division with offices at the Lamp Division headquarters, Bloomfield, N.J. In his new post he will be responsible for commercial engineering problems relating to all photo lamp products including flashbulbs, projection lamps and motion-picture floodlamps. Mr. Wilson is a member of this Society and has been active most recently on the TV Studio Lighting Committee. He joined the Westinghouse Lamp

Division in 1944 after serving as assistant chief of the engineering section of the U.S. Office of Civilian Defense.

Rollo Gillespie Williams has been appointed Manager the Color Lighting Dept., recently established by Century Lighting, Inc. The new department, besides handling all facets of color in lighting, will pursue research and development in light sources, color media, color quality and color control. A member of the Society, Mr. Williams has served for 25 years in the fields of color, stage and architectural lighting.

The Electromation Co., Santa Monica, Calif., has acquired the Hallen Corp., Burbank, which is reported as having been the first U.S. firm to enter the magnetic film recording equipment field. The Kinevox Co., also a pioneer in the motion-picture sound equipment field was acquired by Electromation a year ago. Harold L. Powell, former president of Hallen Corp., will supervise the Kinevox-Hallen Division.

The Comprehensive Service Corp. has announced the opening of a West Coast branch with sales offices and warehouse at 6674 Santa Monica Blvd., Hollywood. Leo Schwartz has been elected Vice-President of the California organization.

section reports

Three meetings of the New York section held on October 25, November 15 and December 6, respectively, had a total attendance of 775. The three meetings were held in New York City at CBS Film Studio A, 20th Century-Fox, and the Carl Fischer Concert Hall, in that order.

Speaker at the October meeting was M. Clay Adams, Manager, Film Production Dept., CBS-TV, who, speaking in the new CBS Film Studio A, described such features as the centralized lighting control system, the communication system between the director in the control booth and the three cameramen on the stage, and the sound recording equipment.

At the November meeting the speakers were Ralph M. Evans, Director, Color Technology Div., Eastman Kodak Co., who spoke on "Sharpness and Contrast in Projected Pictures," and Nicholas H. Groet, Research Laboratories, Eastman Kodak Co., who spoke on "A New Intermediate Positive-Duplicate Negative System." Each of these papers had been presented at the 80th Convention in Los Angeles. Mr. Evans discussed sharpness and contrast effects and presented color illustrations to demonstrate his point that each is independent of the other to a considerable extent. Mr. Groet presented a paper by H. J. Bello, C. E. Osborne and D. M. Zwick describing a new color film for making duplicate negatives from Eastman Color Negative Film Type 5248.

At the early December meeting Maurice Levy, President, Eastern Effects, Inc., spoke on "Motion-Picture Effects for Use on Television." He discussed the function of an "optical house" in the production of television commercials. He traced the history of a commercial from the idea stage to the appearance on the TV screen, and presented illustrations of the intermediate steps.—*B. F. Perry* c/o Westrex Corp., 111 Eighth Ave., New York 11.

The Hollywood Section met December 11 at the Walt Disney Studio, Burbank, Calif., with an attendance of 600. Speakers were J. H. Jacobs, Westrex Corp., Hollywood; L. B. Abbott, Asst. Head, Special Effects, 20th Century-Fox Studios; and Col. J. P. Warndorf, Cmdr., Lookout Mt. Laboratory, 1352nd Motion-Picture Sqdn.

The meeting was opened by Section Chairman Ed Templin who extended his appreciation to the Section for contributing to the success of the activities in 1956.

A motion-picture, *Out at Ott's*, covered time-lapse photography by Jim Ott. Mr. Jacobs then presented his paper on recent developments in light valves, illustrated by slides in black-and-white and color. Mr. L. B. Abbott spoke on "Special Effects in Color" and illustrated his talk with flood scenes from the 20th Century-Fox picture, *The Rains of Ranchipur*, and other special effects.

Col. Warndorf described the facilities at

Lookout Mt. and told how the Squadron had covered nuclear device tests by AEC.

The Section extended its thanks to Walt Disney Studios and Robert Cook for providing a meeting place in the Disney Studio Theater.—*John W. DuVall*, Secretary-Treasurer, c/o E. I. du Pont de Nemours & Co., 7051 Santa Monica Blvd., Hollywood 38.

Biographical Note

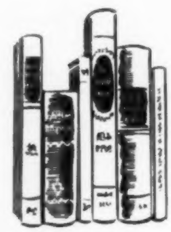
William F. Little, President of Electrical Testing Laboratories, Inc., New York, retired on December 31, 1956. His career began in 1903 when he joined the Electrical Testing Laboratories (then known as the Lamp Testing Bureau), following his graduation from Rutgers. In 1906 he became affiliated with the H. W. Johns-Manville Co. as manager of the Victor Instrument Co. In 1910 he returned to ETL where he remained until his retirement.

Honors accorded him during his long and distinguished career include appointment to the International Commission on Illumination as U.S. Representative of the Committee on Photometric Accuracy. He was made a Fellow of SMPTE in May 1954. He served on the Society's Committee on Screen Brightness from 1948 to 1952. He was elected to various offices in the Illuminating Engineering Society and is both a Fellow and Medalist in that organization. He was made a member emeritus of the IES on the occasion of his retirement. He is a charter member of the Inter Society Color Council, a member of the American Optical Society and other scholastic and professional groups.

During World War I and II he made a considerable contribution to the development of the war-born art of camouflage. In World War I he worked with Thomas A. Edison and his group in designing special equipment and applying theories of brightness and contrast to brightness measurements of the sky, water surface and underwater.

Since 1919 he has been active in testing and helping standardize lights for automobiles and he has greatly influenced present-day safety laws and regulations. He has patented a number of automobile lights, a photometer, a light unit and a portable lamp assembly and at present has patents pending on wall lamps and floor lamps. He has designed and cooperated in the design of various types of photometers and reflectometers. Before 1906, he helped develop and build the first variable autotransformer, later manufactured as the Variac. While he was with the H. W. Johns-Manville Co. he designed the luminaires for general lighting and cage and window lighting, and upon his return to ETL in 1910 as Head of the Photometric Dept., he helped to design and build the first successful photoelectric integrating photometer for measuring of incandescent lamps.

He is the author of a number of papers on such topics as Photometry, Light and Color Measurements, Automotive Lighting Equipment, Certification of Lighting Equipment and others. He is co-editor of the chapter on Illumination in the 7th and 8th editions of the *Standard Handbook for Electrical Engineers*.—*R.H.*



books reviewed

Dictionary of Cinema, Sound and Music in Six Languages

Compiled and arranged by W. E. Clason. Published by Elsevier Publishing Co. Distr. in U.S. by D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N.J. 6 × 9 in. 948 pp. Price: $19.75.

In the February 1956 *Journal*, pp. 85–91, "A Listing of Motion-Picture Technical Terms in Five Languages," by Carlos Connio Santini, attempted to find equivalents in English, Spanish, French, German and Italian for terms in common use among motion-picture men in the various countries. From the letters received, and the demand for reprints, it was evident that the need for such a glossary was widespread. A note in the August *Journal*, p. 450, drew attention to a more ambitious list published in the *Annuario del Cinema Italiano*. This list did not include Spanish, however.

Now, W. E. Clason, who is head of the Translation Dept. at Philips' Electrical Works, Eindhoven, Holland, has put together this impressive dictionary of more than 3200 terms in English, French, Spanish, Italian, Dutch and German, covering words used in music and acoustics as well as in the motion-picture field.

The first and largest section in the book is an alphabetical listing of English terms, each numbered, with definitions in English, and the equivalent terms in the five other languages stretching across each double-page spread. Where variations occur in American and British usage, the variants are shown. This section occupies 751 of the book's 948 pages.

The remainder of the book consists of five lists of the same terms in the other five languages, in which each term is indexed by

item number back to the first section where the definition and equivalents in other languages may be found. This arrangement makes the book primarily of interest to those whose principal language is English, since the only definitions are those given in that language.

However carefully made, any compilation of this kind will be open to some disagreement about the usage or definition of individual terms, and undoubtedly a few of the usages here, particularly of the slangier terms, could be questioned. But the great majority of those pertaining to the motion-picture industry seem to be accurate, and in many cases where apparently some doubt might exist about exact equivalents variants are given in each language.

Those interested in foreign language equivalents of technical terms should note that Elsevier has previously published several other dictionaries in six languages, all of them compiled by Mr. Clason, including one on television, radar and antennas; one on electronics and waveguides; and another on amplifiers, transmitters and receivers. All these are also handled in this country by D. Van Nostrand, Inc.—*D.C.*

Supervision of Scientific and Engineering Personnel

Bulletin No. 26, Compiled by John T. Lloyd and Robert D. Gray. Published (1956) by the Industrial Relations Section, California Institute of Technology, Pasadena, Calif. 82 pp., paper covered, 9 × 11 in. Price $8.75

This bulletin covers such topics as the Characteristics and Development of the Professional Employee, Building and Maintaining a Good Technical Team, the Supervisor's Role in Professional Development, and Organization of a Professional Work Group. It also presents opinions on unionization of professional employees, policies for salary administration, benefit plans and other relevant matters.

Compiled in outline form, it is derived from a number of conferences of experts in the fields of industrial relations, engineering and psychology, and is a composite of the opinions advanced in these meetings. Although the outline is directed to supervisors of engineering personnel and especially those in large organizations, it is also of value for those in personnel work and individuals who may only occasionally be placed in a supervisory capacity.

A remarkably sound and concise compilation, it seems to anticipate and answer any question that could possibly arise in a supervisor-employee relationship on a professional level. While it offers practical assistance to supervisors of engineers, it is also of interest to professional employees of all categories.

A companion bulletin, No. 26A, *Conference Leader's Guide*, is included with Bulletin No. 26 if requested when ordering.

British Broadcasting

Radio and Television in the United Kingdom

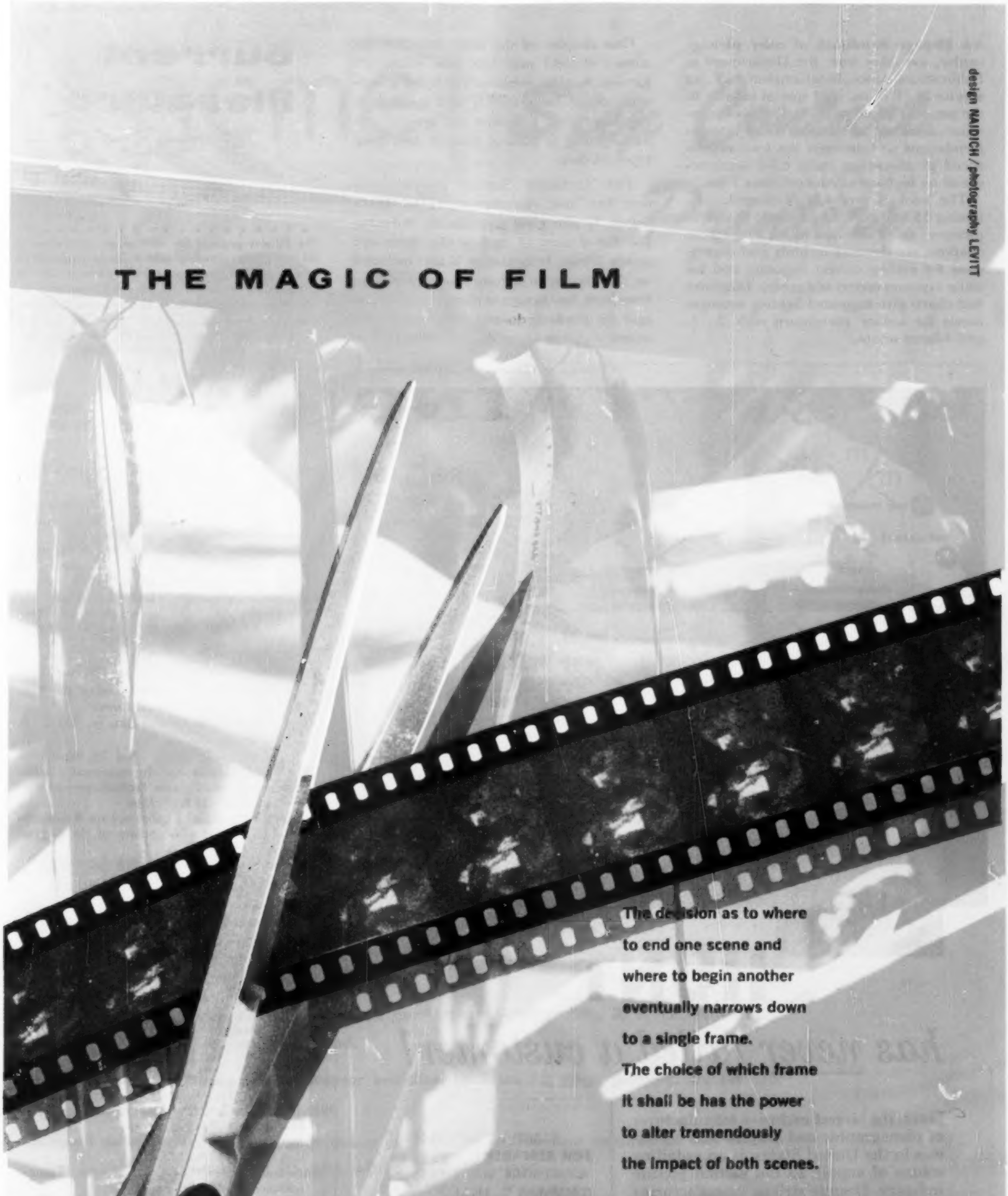
By Burton Paulu. Published (1956) University of Minnesota Press, Minneapolis 14, Minn. 457 pp. Price $6.00

This is an excellent source book for students interested in the historical, sociological and technical values involved in a comparison of British and American broadcasting policies and practices. The author, Dr. Burton Paulu, did the basic research for the book as a Fulbright scholar in London during 1953–54, when the new Independent Television Authority was being debated in Parliament and the British Broadcasting Corp. was laying its plans to meet competition. The author places major emphasis on program descriptions but also discusses audience reactions, staff and technical facilities, and finances.

All of the standards pertaining to metallic electrical conductors, set by the American Society for Testing Materials, have been compiled in a 300-page paper-covered book priced at $3.50. Standards developed by the ASTM Committee B-1 on Wires for Electrical Conductors, and related standards from other ASTM committees are included.

The standards cover: (1) copper, copper alloy and copper covered steel: wire; stranded conductors; rods, bars, and shapes; pipes and tubes; (2) aluminum: wire; stranded conductors; rods and bars; (3) galvanized steel core wire; and galvanized iron and steel guy messenger, span, overhead ground, and line wire.

Further information is available from American Society for Testing Materials Headquarters, 1916 Race St., Philadelphia 3, Pa.


THE MAGIC OF FILM
The decision as to where
to end one scene and
where to begin another
eventually narrows down
to a single frame.
The choice of which frame
it shall be has the power
to alter tremendously
the impact of both scenes.
GENERAL
FILM LABORATORIES CORP.
1546 NO. ARGYLE, HOLLYWOOD 28, CALIF. / NO. 2-6171
Complete 16 mm and 35 mm services
design NAIDICH / photography LEVITT

An 88-page handbook of color photography, available from the Department of Publications, Ansco, Binghampton, N.Y., at a price of 75 cents, is of special interest to the amateur photographer. The book contains detailed instructions and recommendations to help even the least experienced photographer make color transparencies on high-speed Anscochrome Film.

The book is profusely illustrated, containing 53 four-color illustrations as well as pictures in black-and-white. Complete chapters are devoted to hints and suggestions for getting correct exposure and for using exposure meters and guides. Diagrams and charts give suggested lighting arrangements for indoor portraiture with 2-, 3- and 4-lamp setups.

One chapter of the book describes the nature of light and tells how colors are formed. Another explains how lighting contrast affects color fidelity and shows how the experts use reflectors and synchro-sun flashlighting to control contrast and color reproduction.

The Technical Section of the book describes how Anscochrome Film forms colors. It also gives formulas for reducing the dye density of each of the three dye image layers. Information is also included on the making of tricolor separation negatives from Anscochrome film transparencies and for masking to control contrast and colors.

current literature

The Editors present for convenient reference a list of articles dealing with subjects cognate to motion-picture engineering published in a number of selected journals. Photostatic or microfilm copies of articles in magazines that are available may be obtained from The Library of Congress, Washington, D.C., or from the New York Public Library, New York, N.Y., at prevailing rates.

American Cinematographer vol. 37, Sept. 1956
'Moby Dick' Sets New Style in Color Photography (p. 534) *D. Hill*
New Blimp for Arriflex 16 (p. 540)
Eastman Plus-X Panchromatic Negative Film (Type B) (p. 542) *E. Huse*

vol. 37, October 1956
Time-lapse and Telephotos Probe Nature's Secrets (p. 598)
A Method for Syncing the Pre-Scored Playback with the Picture Film (p. 600) *Roy Zeper*
Photographing the Television Image (p. 604)
Operation "Deepfreeze" (p. 606) *Joe Henry*
Photography Aids in Establishing Speed Mark for New Fighter Plane (p. 610) *John Forbes*

British Kinematography vol. 29, Aug. 1956
Synchronous Sound Recording using the Syncropulse Process (p. 41) *N. Leevers*
The Capabilities of 16mm. Film (p. 53) *T. P. Hadingham*

vol. 29, Sept. 1956
The Rome Conference—International Conference on Cinematograph Technology—An Appreciation (p. 82) *H. S. Hind*
Second International Conference on Kinematograph Technology (summary of the papers) (p. 26)
Anamorphotic Optical Printing (p. 89) *G. H. Cook*

International Projectionist vol. 31, Sept. 1956
Development of the Super Cinex Lamp (p. 7) *C. S. Ashcraft*
Magnetic Tracks on Release Prints (p. 10) *R. A. Mitchell*

Kino-Technik vol. 10, Sept. 1956
Deutsche Kinotechnik im Filmbild der Welt (p. 318)
Kino-ein Magnet für die Völker im Vorderen Orient (p. 322) *K. Braune*
Drei Jahrzente Film—und Kinoförderung in Persien (323) *E. u. A. Surkow*
Pakistan—junger Staat mit eigener Filmproduction (326) *Dr. Brocksien*
Indonesien—Land mit wechselnder Filmgeschichte (p. 328) *Dr. Brocksien*
Hindustan—das drittgrösste Filmland der Gegenwart (p. 330) *Dr. Brocksien*
Japan—zweitgrösstes Filmproduktionsgebiet der Welt (p. 334)
Barrandov—die môderne Filmstadt der Tschechoslowakei (p. 336)
Erster Rundgang durch die "Photokina 1956" in Köln (p. 348)

Philips Technical Review
vol. 18, No. 3, 1956–57
A Pentode Gun for Television Picture Tubes (p. 73) *J. C. Francken, J. deGier,* and *W. F. Nienhuis*

Proceedings of the IRE vol. 44, Sept. 1956

A New Beam-Indexing Color Television Display System (p. 1108) *R. G. Clapp, E. M. Creamer, S. W. Moulton, M. E. Partini* and *J. S. Bryan*

Directions of Improvement in NTSC Color Television Systems (p. 1125) *D. Richman*

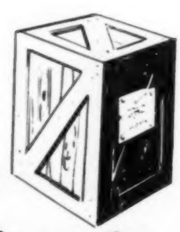
RCA Reviews vol. 17, June 1956

Recent Improvements in the 21AXP22 Color Kinescope (p. 143) *R. B. Janes, L. B. Headrick,* and *J. Evans*

vol. 17, Sept. 1956

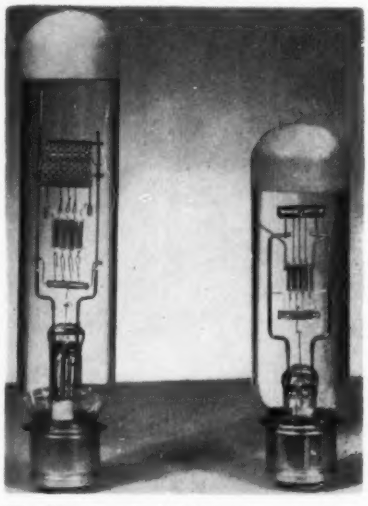
A Magnetic Tape System for Recording and Reproducing Standard FCC Color Television Signals *H. F. Olson, W. D. Houghton, A. R. Morgan, M. Artzt, J. A. Zenel,* and *J. G. Woodward*

Printed Circuits, a bibliography covering most published and some unpublished material on the subject of printed circuits and allied techniques, has been issued by the Television Society of Great Britain. The articles, arranged in alphabetical order, are cross-referenced in eight sections. Lists of authors and periodical abbreviations are included. The bibliography is available from the Society's headquarters at 164 Shaftesbury Ave., London W.C.2, at a price of 2s. 6d. The bibliography was prepared by Mrs. K. Bourton of Ultra Electric Ltd.



new products
(and developments)

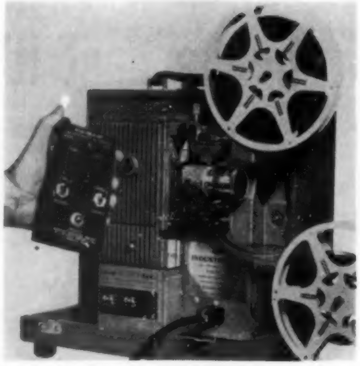
Further information about these items can be obtained direct from the addresses given. As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of these items does not constitute endorsement of the products or services.



The Blue Top T-12 1200-w lamp has been developed by the Lamp Division of Westinghouse Electric Corp. to be interchangeable with 1000-w lamps. Nearly 2 in. shorter than the older type 1200-w lamp, the new light source has the same filament size as 1000-w lamps. Originally designed for use by the armed services, the new lamp is described as useful wherever the problem of insufficient screen brightness is present.

The Dustroyer, an air purifier for photographic darkrooms, is a product of the Miller-Trojan Co., 1083 W. Main St., Troy, Ohio. The unit, mounted between the studding in the darkroom wall, is designed to pump dust-free air into the darkroom and "pressurize" the interior to expell stale air and dust particles. The "light-tight" unit is operated by a single toggle switch and plugs into any 110-v a-c outlet.

The new 1957 (21st) edition of the *Radio-Electronic Master* has been published with 1546 pages and over 125,000 items of 350 manufacturers included with detailed descriptions, specifications and prices. There are about 11,250 illustrations included. The catalog may be obtained from electronic parts distributors. Names will be supplied on request by United Catalog Publishers, Inc., 110 Lafayette St., New York 13.



The L-W Industrialist is a projector for critical analysis of 16mm motion-picture films. A modification of an Eastman Kodak Kodascope 16mm silent Analyst Projector, the adaptations include forward and reverse projections in a range from 6 to 24 frames/sec with remote control. A single still picture can be projected for prolonged study in full illumination. The unit is portable and operates in its case and includes a daylight projection viewer. Film capacity is 400 ft. Cooling is provided by a constant-speed motor for blower service. The unit is manufactured by the L-W Photo Products Co., Los Angeles, and is being retailed by Ralke Co., 829 S. Flower St., Los Angeles 17.

The new 72-page edition of ***Kodak Color Films***, published by the Eastman Kodak Co., Rochester 4, N.Y., is available from Kodak dealers for 75 cents. This is the first complete revision of the Data Book since its introduction. The new edition includes data sheets on the higher-speed, higher-definition Kodak Ektachrome Films designed for Process E-2, and the new negative films, Kodak Ektacolor, Type S. Material on color balance and speed has been expanded to form a new section on the critical use of color films. The section is illustrated in color. Subjects discussed in detail include types of film, filter data, storage before and after processing, processing, viewing transparencies, critical use, and prints and duplicates.

Another new Kodak booklet, *Kodak Chemical Preparations*, describes Kodak photographic chemicals used by amateur and professional photographers in processing black-and-white films, plates and papers. The 12-page booklet gives recommended uses, available quantities and prices for developers, fixers and stop bath materials, toners, intensifiers, reducers, lacquers, protectants, special processing and miscellaneous darkroom chemicals. It is available at no charge from Kodak dealers.

Camera Equipment Co., 315 W. 43 St., New York 36, has been appointed exclusive distributor in the United States for all Maurer Cameras and recording equipment. This includes the Maurer Professional 16mm Camera which was designed with all indicators and controls directly at hand from shooting position so that the cameraman need not change position. The firm's repair department is now service headquarters for all Maurer equipment and accessories.

An auditorium-size compatible color TV projection system (TLS-50), which produces pictures up to $4\frac{1}{2} \times 6$ ft for audiences of approximately 500 persons, has been developed by the Radio Corporation of America for closed-circuit applications. It is scheduled for commercial production in the near future and is planned to cost about $4250. The system can also be used for projection of closed-circuit monochrome programs. Scheduled for commercial availability at the same time and at the same price is an RCA auditorium-size monochrome projection system (TLS-51), identical with the color TV system except that it utilizes black-and-white instead of color projection tubes. The black-and-white projection system produces pictures up to 6×8 ft. The color and monochrome projection systems are intended for use with directional screens having a gain of two-and-a-half times. With such screens the useful seating area covers a total angular width of 60°.

Catalog information on Foto-Video Laboratories' Model V-6 Convergence Dot Generator may be obtained by writing to the firm at 31 W. 47 St., New York 36. The unit is used for the adjustment of the convergence of shadow mask tricolor kinescopes as used in color TV receivers or monitors. It also checks linearity of both color and monochrome monitors or receivers. The spec sheet contains descriptions of the features, applications and specifications of the unit.

The Projection Optics Co., 330 Lyell Ave., Rochester 6, N.Y., has announced a high resolution test pattern especially designed for testing optics used in the projection and taking of motion pictures. Called the Hilux Motion Picture Test Chart, this glass resolution test chart was laid out along the same line as the American Standard PH 3.16-1947 (Revised 1952) except that the frames cover the various aperture plate sizes listed as follows: Academy Frame, 0.825 in. × 0.600 in.; Magnetic CinemaScope, 0.912 × 0.715 in.; Cinerama, 0.997 × 1.120 in.; Horizontal VistaVision, 1.148 × 0.772 in.; 55mm CinemaScope, 1.306 × 1.065 in.; Todd-AO, 1.948 × 0.906 in.; M-G-M 65 mm, 2.050 × 0.870 in.

In addition to these frames, standard resolution test patterns are in the center and in the corners of each frame. A limited number of these test plates are available at a price of $87.50 each. The size of this glass chart is 2.500 × 2.000 in. If these test charts are used in conjunction with projection bulbs, cooling is required as the glass plates are not heat-resistant.

The Cinema Engineering Division of Aerovox Corp., Burbank, Calif., has issued a catalog of Cinema Encapsulated Resistors, Bulletin No. LC-1030BX. The 20-page catalog, issued yearly, includes a Military Specification tabulation. Cinema resistors include the CE 100 and CE 200 series, radial wire terminals or radial lug terminals and the PW 100 and PW 200 series for printed circuitry, axial wire terminals or radial lug terminals. The catalog may be obtained from the factory at 1100 Chestnut St., Burbank, Calif.

The Radio Corporation of America has started commercial production of its compatible color TV camera system designed for medical use, with the first units going to Walter Reed Army Medical Center, Washington, D.C. The medical camera (TK-45) is designed around three vidicon camera tubes and special electronic circuitry which makes it possible to televise surgical procedures in full-color detail under normal operating-room lighting. It measures 26 × 15 × 14 in., weighs less thn 200 lb and, to eliminate interference with surgery or demonstrations, is designed for permanent installation in an overhead fixture which supports both camera and surgical lamp. The camera also can be incorporated into a microscope system for direct televising of microscopic specimens, enabling a single instructor to display full-color microscopic enlargements to an entire class or to groups of classes tied into a closed-circuit network.

An RCA ultraviolet-sensitive TV camera tube is making possible a large step forward in cancer research. This developmental tube is used in an unusual application of closed-circuit TV that involves the use of a high-power microscope and an electronic oscilloscope to obtain direct observations and oscillographic measurements of the metabolism of living cells. This new research technique is now being used on an experimental basis at the National Institutes of Health, Bethesda, Md.

The new technique enables researchers to observe and take motion pictures, simultaneously, of chemical activity within living cells; make a microscopic study and analysis of hundreds of living cells in only a fraction of the time formerly required and make direct observation and identification of certain chemical changes within the cells.

The ultraviolet television system employs a standard RCA black-and-white TV camera, type TK-21. The camera's standard monochrome vidicon tube has been replaced with the ultraviolet-sensitive vidicon camera tube. The pickup tube and its circuitry were developed originally at RCA's David Sarnoff Research Center under the supervision of Dr. V. K. Zworykin.

The Radio Corporation of America will install a television system including a complete on-the-air and closed circuit TV broadcast studio in the University of Georgia's new Center for Continuing Education. The Center will also include an off-campus 25-kw broadcast transmitting plant, live and film camera systems for studio origination of program material and 167 RCA Victor TV receivers for closed-circuit presentation of studio programs in various study and discussion rooms.

Wire-wrapping tools powered either by air or electricity have been announced by Ingersoll-Rand, 11 Broadway, New York 4. The handheld wire wrappers can be set in six different positions to make wire insertion easy from any angle. The tools are designed to make speedy electrical connections in radio, TV and other electrical, electronic and electro-mechanical assemblies.

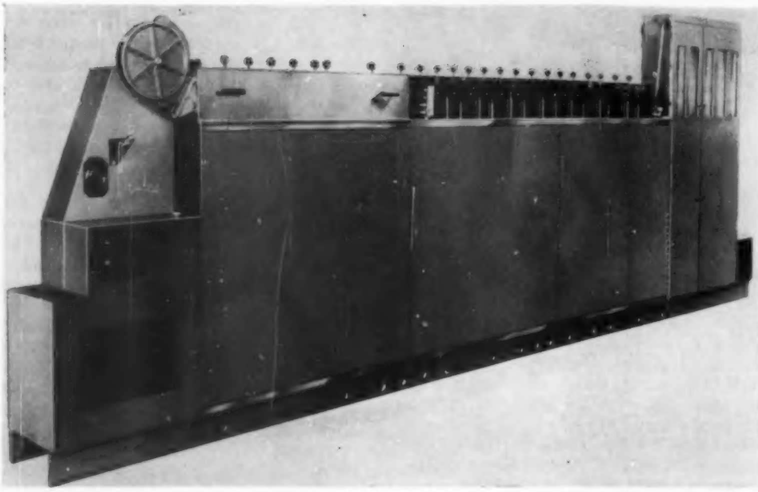
A new series of lenses made by the English firm of Taylor Hobson Cooke especially for the Arriflex 35 has been announced by Kling Photo Corp., New York and Los Angeles, distributors of Arriflex Mirror-Reflex Motion Picture cameras. The T.H.C. Speed Panchro lenses are calibrated in f-stops as well as T-stops for use in professional cinematography and are fitted with follow-focus lever to permit continuous focusing through the Arriflex Reflex Finder during actual shooting of dolly shots. The following lenses are now available: 18mm f:1.7/T2 Extreme Wide Angle lens, $731; 35mm f:2/T2.3, $340; 50mm f:2/T2.3, $340; 75mm f:2/T2.3, $340.

Type 834 TV Recording Film has been introduced by E. I. du Pont de Nemours & Co., Photo Products Dept., Wilmington, Del. Reported to be approximately two and one-half times faster than Type 824, which it replaces, the film is designed for photographing either negative or positive images on TV monitor tubes. It is available in 16mm and 35mm sizes.

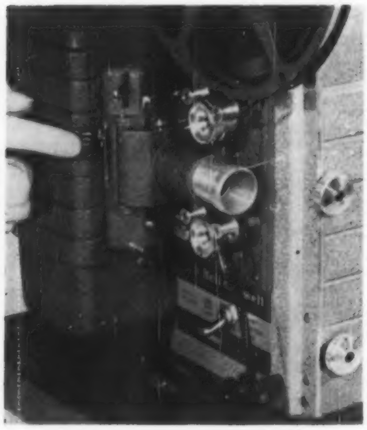
The Automax, a 35mm cine-interval camera, was recently tested at Edwards Air Force Base. The camera was reported to be operating efficiently at 30 g, a temperature of −65 F and an altitude of 50,000 ft. Further information about the camera, including details of test results, is available from Traid Corp., 17136 Ventura Blvd., Encino, Calif.

K. Phillips Kallman has announced the organization of Sales Meeting Equipment, Inc., 1210 N. Hoyne St., Chicago 22. The new firm will manufacture portable wide-ratio and large standard-ratio screens and special projectors designed primarily for sales organizations conducting multi-city sales and product presentation meetings. Kallman was formerly associated with the N.Y. Museum of Science and Industry and was exhibit manager of Brookhaven National Laboratories. At that time he was a member of this Society's Museum and Historical Committee.

Conrac, Inc., Glendora, Calif., has announced a new 21-inch color TV monitor, the CH21B. This is an improvement model of the company's original monitor. The new unit is a self-contained picture monitor that operates from either NTSC encoded color video signals or from simultaneous red, blue and green signals. It employs a three-gun, tricolor picture tube of the type 21AXP22A. All operating and set-up controls as well as a test point for Y, I, Q, R, G or B are accessible from the front. Schematics, engineering data and specifications may be had from the manufacturer.

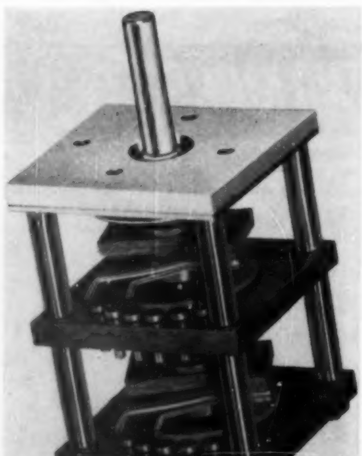


A Color Labmaster, Model 16ARC15, for processing reversal color film has been introduced by Houston Fearless, 11801 West Olympic Blvd., Los Angeles 64. The new machine is an addition to the company's series of Labmaster film processors. It is straight 16mm or 16/35mm combination. Normal processing speed for 16mm Anscochrome is 15 ft/min with variable speed control to allow for processing at a higher exposure index. It is adaptable to processing other color emulsions as well as black-and-white. The unit is 217 in. × 16 in. × 60 in., and weighs 1600 lb.



The 253-AR Monterey Deluxe projector has been announced by Bell & Howell, 7100 McCormick Rd., Chicago 45. The new model is similar in appearance and design to the present Monterey projector, but has an added reverse and still picture control. A safety shutter protects film from heat during still picture projection. Because of the fixed axis framing feature, it is not necessary to readjust the tilt when framing. The list price is $99.95, including Federal Excise Tax and the aluminum case.

Bell & Howell has also announced a new wide-angle attachment for their 16mm electric eye motion-picture camera which converts the camera's 20mm lens to a wide-angle focal length of 13.2 mm without affecting the ability of the lens to set itself automatically for proper exposure. The attachment is also designed for use with the 20-mm Sunomatic lens on the Bell & Howell 200-S camera and the 1 in. $f/1.9$ Super Comat lens without affecting exposure or setting. When used with a 1-in. lens its focal length is 17 mm. The attachment is priced at $59.95, complete with size 6 filter retainer and metal front and rear lens caps.



A new series of switches has been announced by Cinema Engineering Div., Aerovox Corp., Burbank, Calif. The new switches were developed in response to requests for CES switches with substandard mounting dimensions. All Cinema switches are now available as replacements for existing substandard mounted switches. The special mounting is designated as DES instead of CES in Catalog No. 17-S available from the company upon request. Variations in accessories include special terminal boards, dust covers, ball bearings, stainless shafting, coin silver contacts, special detent positions and high-voltage construction.

J. G. McAlister Inc., 1117 N. McCadden Pl., Hollywood 38, has announced a spring-loaded, toggle-operated socket which is reported to eliminate arcing on any type of bipole lamp. The 5-kw and 10-kw McAlister lamps and skypans are now equipped with the new socket.

Journals Available

These notices are published as a service to expedite disposal and acquisition of out-of-print Journals. Please write direct to the persons and addresses listed.

Recent issues available. Write: F. H. Cole, 144 Via Trieste, Newport Beach, Calif.

Jan. 1930 through Dec. 1937; Journal SMPE issues; and Jan. 1930 through Dec. 1935, bound volumes of SMPE Journal; SMPE Transactions: Apr. 1919:8, May 1920:10; May 1922:13; Oct. 1922:15; May 1925:21; Oct. 1925:24; Apr. 1927: 30; Sept. 1927:32; Apr. 1928:33; Sept. 1928:36; SMPE Membership Listings: 1928, 1930, 1938; SMPE Index and Authors: 1930–1935; SMPE Miscellaneous: ASA Z22—1930; Dim Stab of M.P. Films 1934; ASA Z22—1935; High Intensity Lamps—1935; Program Spring Convention Apr. 26, 1939. Write John Faber, 5 Edgewater Drive, Denville, N. J. Phone Rockaway 9-2623M.

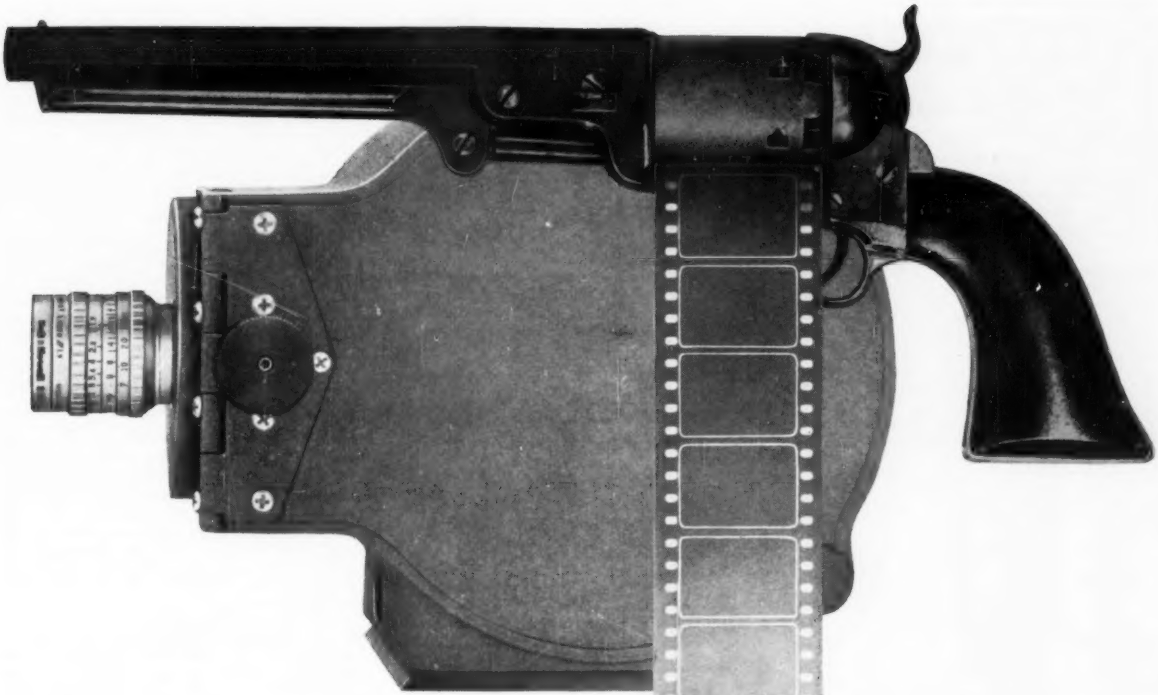
Complete set of Transactions and Journals 1917 to date; 61 volumes beautifully bound in black library buckram with gold-stamped backs through 1952; all subsequent issues ready for binding to match; for sale as a set only. Also for sale individually: Jan.–June 1932; Aug. 1938; Feb., Mar., May–Oct., Dec. 1941; Jan.–Dec. 1942; Jan., Mar.–Dec. 1943; Jan.–July, Dec. 1944; Jan.–Mar. 1945; Apr. 1946; Mar. Pt. I 1949; Sept. 1950; Index 1936–1945, 1946–1950; Membership Directories 1952, 1954. Write: Henry M. Lester, 270 West End Ave., New York 23.

Complete set of Journals from May 1937 to June 1954, including special volumes and membership directories, excellent condition; also Mar., May 1934 and July 1935 issues. Write: Harry R. Lubcke, 2443 Creston Way, Hollywood 28, Calif. HO 9-3266.

Jan.–Dec. 1950; Jan., Feb., Apr.–Dec. 1951; Jan.–Mar. 1952. Also available are vols. 6 and 7 of the The Television Society (British) covering the period Jan. 1950 through Sept. 1955. Write: Andrew N. McClellan, 65 Hillside Drive, Toronto 6, Ont., Canada.

July–Dec. 1952, Jan.–Nov. 1953, Jan.–Apr., June–July, Sept.–Dec. 1954, Jan.–Mar. 1955. Write: Omar Marcus, 1925 Cadiz St., New Orleans 15, La.

Dec. 1946, Feb.–Dec. 1947, 1948–1955 complete. All copies in perfect condition; for sale as entire lot only. Write: Joseph W. MacDonald, 2414 Sullivant Ave., Columbus 4, Ohio.



Old hand at sharp shooting

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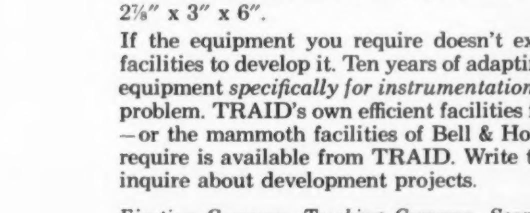

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employment service

These notices are published for the service of the membership and the field. They are inserted three months, at no charge to the member. The Society's address cannot be used for replies.

Positions Wanted

Administrative Engineer. The SMPTE's Staff Engineer, Henry Kogel, is seeking a new position, after 6 years working with SMPTE Engineering Committees and the motion-picture standards program; also serving as Secy, American Standards Assn. Sec. Committee PH22, and Tech. Secy, International Standardization Orgn. Tech. Com. 36, Cinematography; 2 years, previously, develop. engr. with Sperry Gyroscope Co.; B.S. Elec. Eng., Columbia Univ., 1948, after military service as radio off.; age, 37; married; N. Y. area pref.; complete résumé upon request—Henry Kogel, 19–24 202 St., Bayside 60, N. Y.; Tel. BAyside 9-3574, or at SMPTE, LOngacre 5-0172.

Photographic Development Engineer. Free-lance or consultation. Long experience in design, development and production engineering of both military and commercial motion-picture and still cameras and projectors, enlargers, film editors, lapsed time and sequence cameras, viewers, automatic aperture controls, stereographic, press cameras, etc. Military and commercial references available on request. Write: P.O. Box 601, Jamaica 31, N.Y.

Radio-Television Production or Directing Assistant. January graduate Boston Univ. (B.S. Communication Arts). Experienced AM-FM-TV engineer (First Class Radio-Telephone License). Radio production and directing experience. Desire position with radio or TV station specializing in live programming or with TV film organization. Complete résumé on request. Louis Maggi, 110 Lonsdale St., Dorchester 24, Mass.

Sound Recordist-Mixer-Editor. 18 years experience as broadcast and recording studio technician, including 2½ years variable area sound film, double system. Moviola editing and cutting. Formal musical education, read long score. Transmission systems design, maintenance and installation. Past 5 years as Technical Director and Production Assistant for network package producer with own facilities. Duties included multiple tape re-recording and editing with responsibility for selection of b.g. music and effects. Administrative. Highly specialized in "trick" audio, producing over 1100 of these shows for ABC-Radio. Some camera experience, own Cine Special. Detailed résumé on request. 38 years old, married, stable. Wm. Mahoney, 69 Tokeneke Rd., Darien, Conn.

Motion Picture and Television Production December graduate of Television Workshop; thorough knowledge of film and television techniques, including film transmission equipment, kinescope recording, optics, film markets, library methods. Specialty film genealogy, set lighting and decorating, and electrical effects. Currently secretary of the Society of Cinema Collectors and Historians. Age 33, married. Résumé on request. Larry Morales, 37-16 55th St., Woodside, N. Y.

Positions Available

Motion Picture Equipment Sales Representative. Familiar with professional production equipment. Write fully or call Mr. Florman, Florman & Babb, Inc., 68 West 45th St., New York 36. MU 2-2928.

Motion Picture Equipment Maintenance Men. Expert on Mitchells, Bell & Howells, Auricons, Cine Specials, Moviolas, amplifiers, etc. Write fully or call Mr. Florman, Florman & Babb, Inc., 68 West 45th St., New York 36. MU 2-2928.

Television Film Director. Major department head with proven record of administrative, technical and leadership ability sought by WPIX, New York, to supervise all film operations at station. Man with outstanding qualifications will be offered salary in five figures. Write full details to: L. J. Pope, WPIX, Inc., 220 East 42d St., New York.

Top Sales Engineer for projection carbons. Nationwide or territorial. Must have extensive experience in the field and good contacts. Write: Suite 3403, 70 Pine St., New York 5.

Professional Services

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Meeting Calendar

American Institute of Electrical Engineers, Winter General Meeting, Jan. 21–25, 1957, Hotel Statler, New York.
American Physical Society and American Association of Physics Teachers, Jan. 30–Feb. 2, Hotel New Yorker, New York.
Audio Engineering Society, West Coast Convention, Feb. 7, 8, 1957, Ambassador Hotel, Los Angeles.
National Photographic Show, Feb. 16–24, 1957, New York Coliseum, New York.
Deutsche Kinotechnische Gesellschaft, Mar. 7–9, Technical University, Berlin, Germany.
Optical Society of America, Mar. 7–9, 1957, Statler Hotel, New York.
Radio Engineering Show and IRE National Convention, Mar. 18–21, 1957, New York Coliseum, New York.
American Physical Society, Mar. 21–23, 1957, U. of Pennsylvania, Philadelphia, Pa.
International Photographic Exposition, Mar. 22–31, 1957, National Guard Armory, Washington, D. C.
American Chemical Society, Apr. 7–12, 1957, Miami, Fla.
National Academy of Sciences, Apr. 22–24, 1957, Washington, D. C.
Symposium on the Role of Solid State Phenomena in Electric Circuits, Polytechnic Institute of Brooklyn, Apr. 23–25, 1957, Engineering Societies Building, New York.
American Physical Society, Apr. 25–27, 1957, Washington, D. C.
Electronic Components Symposium, May 1–3, Morrison Hotel, Chicago
Acoustical Society of America, May 23–25, New York.
81st Semiannual Convention of the SMPTE, including Equipment Exhibit, Apr. 29–May 3, 1957, Shoreham Hotel, Washington, D. C.
American Society for Testing Materials, June 16–21, 1957, Chalfonte-Haddon Hall, Atlantic City, N. J.
American Institute of Electrical Engineers, Summer General Meeting, June 24–28, 1957, Montreal, Que.
Western Electronic Show and Convention, Aug. 20–23, 1957, Cow Palace, San Francisco
82nd Semiannual Convention of the SMPTE, including Equipment Exhibit, Oct. 4–9, 1957, Philadelphia-Sheraton, Philadelphia.
83rd Semiannual Convention of the SMPTE, including Equipment Exhibit, April 21–26, 1958, Ambassador Hotel, Los Angeles.
84th Semiannual Convention of the SMPTE, Oct. 20–24, 1958, Sheraton-Cadillac, Detroit.
85th Semiannual Convention of the SMPTE, including International Equipment Exhibit, May 4–8, 1959, Fontainebleau, Miami Beach.
86th Semiannual Convention of the SMPTE, including Equipment Exhibit, Oct. 6–10, 1959, Statler, New York.

SMPTE Officers and Committees: The rosters of the Officers of the Society, its Sections Subsections and Chapters, and of the Committee Chairmen and Members were published in the April 1956 Journal.

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National Screen Service Corporation
National Theaters Amusement Co., Inc.
Neighborhood Theatre, Inc.
Neumade Products Corp.
Northwest Sound Service, Inc.
Panavision Incorporated
Pathe Laboratories, Inc.
Polaroid Corporation
Producers Service Co.
Projection Optics Co., Inc.
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